

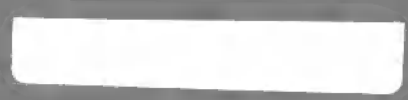
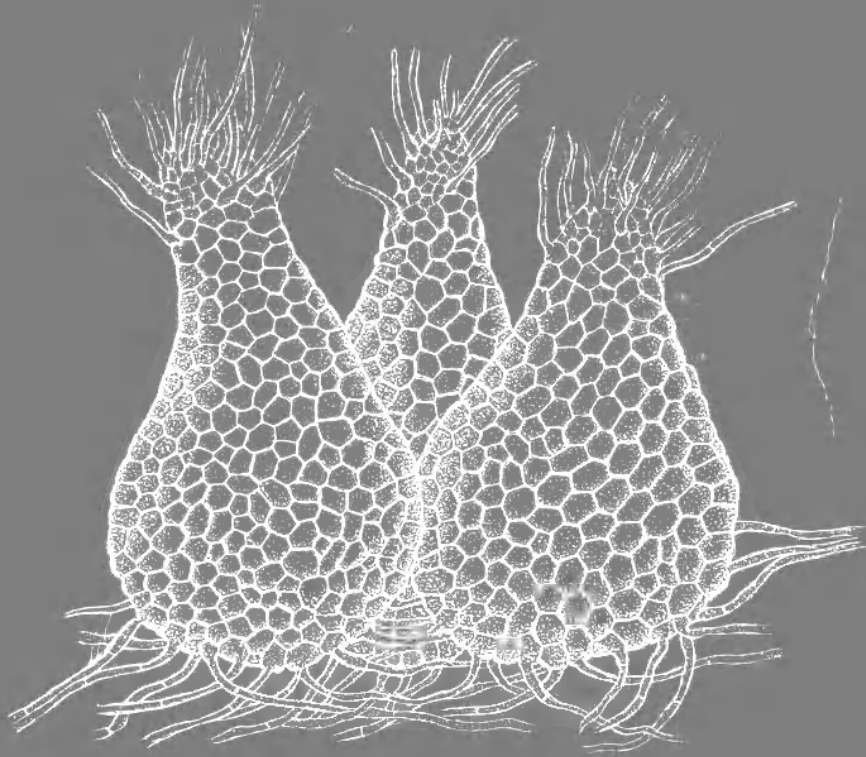
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ISSN 0181-1584

# CRYPTOGAMIE

## MYCOLOGIE

TOME 18 Fascicule 4 1997



# CRYPTOGAMIE

## Mycologie

ANCIENNE REVUE DE MYCOLOGIE  
fondée par R. Heim en 1936

**Directeur de la publication :** Hélène Bischler-Causse  
**Rédaction :** Bruno DENNETIÈRE & Jean MOUCHACCA  
**ÉDITEUR :** A.D.A.C. — 12 RUE BUFFON F-75005 PARIS

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# CRYPTOGAMIE

## MYCOLOGIE

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*Cryptogamie, Mycol.* 1997, 18 (4): 285-360



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## ***CLADOCHASIELLA DIVERGENS* gen. et sp. nov.**

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**ABSTRACT** — The mitosporic fungus *Cladochasiella divergens* gen. et sp. nov. is described as a contaminant from culture of a freshwater hyphomycete. It produces holoblastic elongate conidia arranged in basifugal sympodial chains.

**KEY WORDS:** mitosporic fungi, hyphomycetes, systematics, new taxon

**RÉSUMÉ** — *Cladochasiella divergens* gen. et sp. nov. (Hyphomycetes) est décrit. Cette espèce apparaît comme contaminant des cultures d'hyphomycètes d'eau douce. Elle produit des conidies holoblastiques en chaînes sympodiales basifuges.

**MOTS CLEFS:** Hyphomycètes, systématique, nouveau taxon.

*Cladochasiella divergens* n. gen. n. sp. appeared in a culture of *Fontanospora fusiramosa* Marvanová et al. (1997) after its revival from storage in distilled water. The original habitat of *C. divergens* is unknown.

The terms describing conidiogenous loci are adopted from Hennebert & Sutton (1994).

### **DESCRIPTION**

#### ***Cladochasiella* Marvanová gen. nov.**

Etym.: *clados* (Greek) = branch, *chasis* (Greek) = fission; the suffix “-chasium” is used in botanical terminology for sympodially arranged branches in some inflorescences.

*Fungi mitosporici, Hyphomycetes. Teleomorphosis ignota.*

*Hyphae hyalinae, ramosae, septatae. Conidiophora semimacronematosa. Conidiogenesis holoblastica. Cellulae conidiogenae incorporatae. Conidia elongata, catenata, omnia*

*sub apice elementi precedenti orientia; catenae fractiflexae, simplices vel ramosae. Dehiscencia conidiorum schizolytica.*

Mitosporic fungi, Hyphomycetes. Teleomorph unknown. Hyphae hyaline, branched, septate. Conidiophores semimacronematous. Conidiogenesis holoblastic. Conidiogenous cells integrated. Conidia elongate, catenate, each arising below the apex of the parent element. Chains fractiflexuous, simple or branched. Secession of conidia schizolytic.

**Type species:** *Cladochasiella divergens* Marvanová sp. nov. (Figs 1, 2)

Etym.: *divergens* (Lat.) = diverging; describes the appearance of the branched conidial chains.

*Coloniae monosporicae albae, deinde brunnescentes, modice crescentes. Mycelium aerium copiosum, funiculosum, hyphis 1.5-4 µm latis, pars reversa coloniae brunneo-aurantiaca. Mycelium in substrato hyalinum, hyphis usque ad 5 µm latis; cellulae inflatae elongatae, usque ad 8 µm latae adsunt.*

*Conidiophora apicalia, 3-5 µm lata, simplicia vel ramificata, leniter nodosa, rami acrotoni, alternati vel oppositi, usque ad 100 × 3-5 µm, saepe ut segmenta breviora secedentes. Cellulae conidiogenae incorporatae, apicales vel intercalares, cum uno vel nonnullis locis conidiogenis. Loci apicales vel laterales, monoblastici, cicatrices denticulatae, latae, non-incrassatae. Conidia blastica, in catenis sympodialibus, simplicibus vel ramificatis, saepe dichotomis et late divergentibus, raro alternatis vel oppositis vel adjacentibus connexa, in segmenta breviora vel conidia singularia fragmentantibus. Conidiorum initiatio hologena, dehiscencia schizolytica, cicatrices saepe excentricae. Conidia clavata, nonnumquam inaequilateralia vel allantoidea, raro bacilliformia, continua vel usque ad 4-septata, (5-)15-30 (-45) × 2.5-4 µm.*

Monoconidial colonies (2% malt agar, 15°C, diffuse light) off-whitish, becoming brownish with age, growing moderately fast, reaching 9-10 mm diam. after 11 days, aerial mycelium abundant, funiculose, hyphae 1.5-4 µm wide, reverse brown with orange hue. Advancing hyphae straight, loosely arranged, first branch c. 130-200 µm below the hyphal apex. Substrate mycelium hyaline, hyphae up to 5 µm wide, with inflated elongate segments up to 8 µm wide. Sporulation copious on the water surface and above water within a few days of submergence of a piece of the agar culture in standing distilled water, but scanty when the culture is aerated under water. The upper layer of the substrate mycelium becomes darker brown after submergence in light, but all its elements remain hyaline. Conidiophores apical, integrated with hyphae and hence their lower end undetectable, 3-5 µm wide, simple or branched, somewhat nodose, branches acrotonous, alternate or opposite, up to 100 × 3-5 µm, often fragmenting and seceding as clavate, septate segments. Conidiogenous cells integrated, apical or intercalary, uni-to multilocal. Conidiogenous loci apical or lateral, monoblastic, secession scars broad, unthickened, on truncate denticles. Conidia blastic, sequential, in simple or branched sympodial chains, branches often dichotomous and then broadly diverging, rarely alternate or opposite or adjacent on the same side of the parent element (fig. 2B); chains breaking down randomly into smaller units, in older cultures up to individual conidia. Each conidium hologenous, arising below the apex of the preceding element, secession schizolytic, detachment scar often eccentric, unthickened, truncate. Single conidia clavate, sometimes inequilateral, or allantoid, rarely bacilliform, continuous or up to four-septate, (5-)15-30 (-45) × 2.5-4 µm.

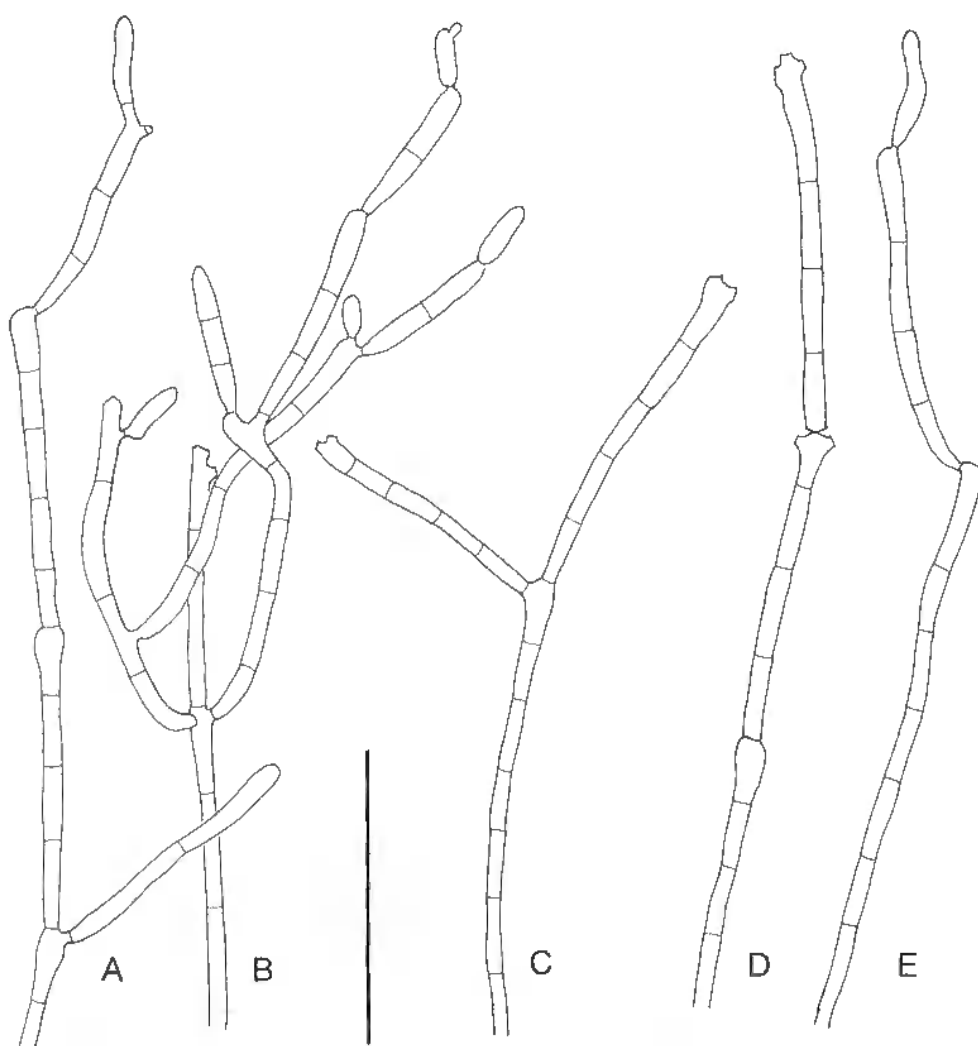


Fig. 1. — *Cladochasiella divergens* CCM F-13489, conidiogenous structures. A, B: branched conidiophores with developing conidia and spent conidiogenous cells. C, D: spent conidiophores. E: simple conidiophore with developing conidia. Scale bar = 50  $\mu$ m.

Holotype: **PRM** 842967, ex CCM F-13489. Culture examined: CCM F-13489, a contaminant isolated from a storage bottle with distilled water and a culture of *Fontanospora fusiramosa* CCM F-12089.

Conidia of this fungus have probably been seen by Ingold & Ellis (1952, fig. 1, e) in scum on a freshwater tidal ditch at Wheatfen near Norwich, U.K. The original habitat of our fungus remains unknown.

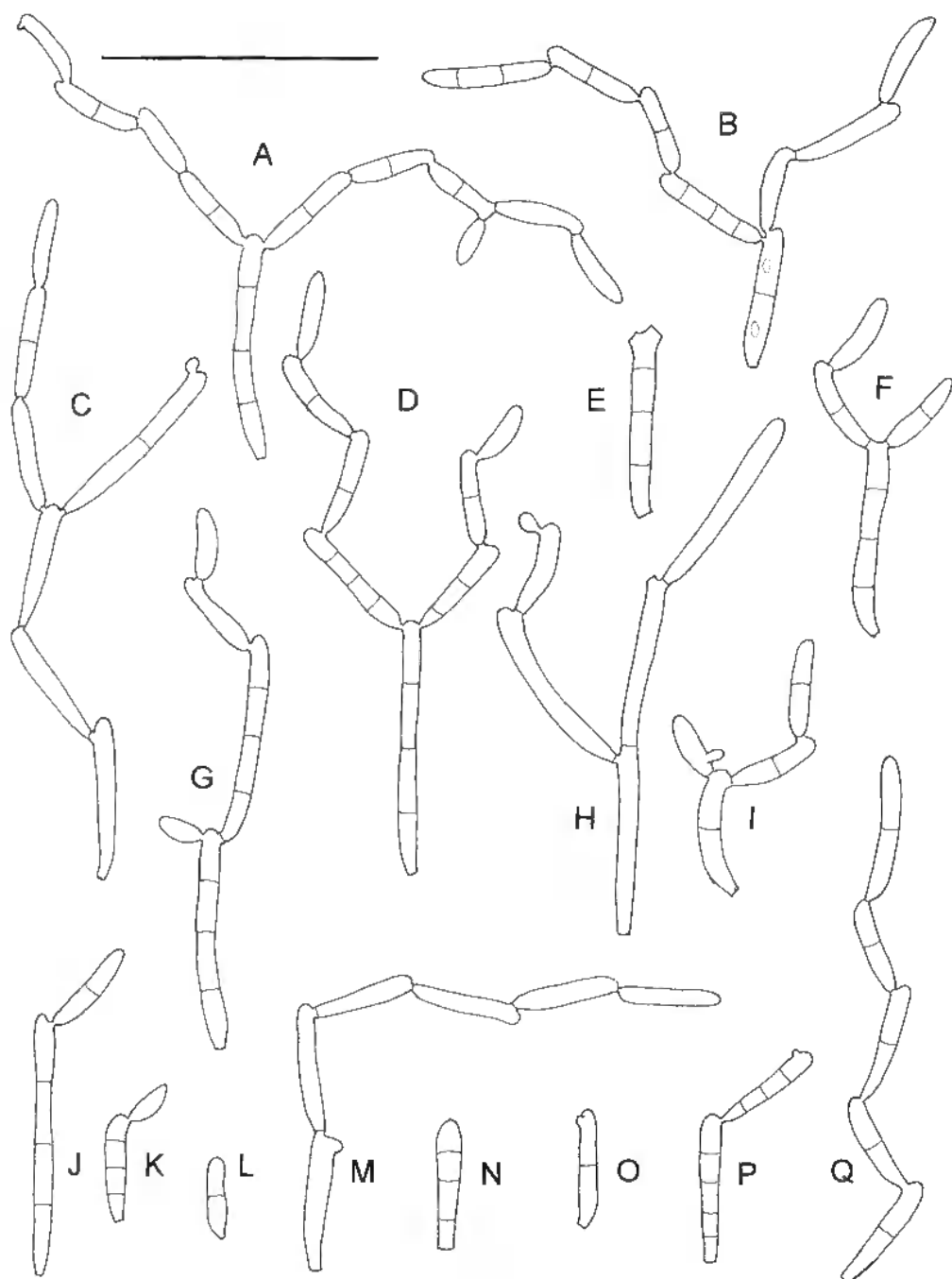


Fig. 2. — *Cladochasiella divergens* CCM F-13489, conidia. A, C, D, F, I: dichotomously branched chains of conidia. B: conidium bearing two adjacent chains of conidia. G: Conidium with two subapical opposite elements. H: conidium with single subapical conidium and lateral chain of conidia, in alternate position. J, K, P: small units of conidial chains. E, L, N, O: single conidia. M, Q: unbranched conidial chains. Scale bar = 50  $\mu$ m.



## DISCUSSION

The interpretation of the fertile structures is not unequivocal. They may be understood as complex, branched conidia composed of short segments, or as chains of simple conidia, remaining connected at least in young stages. Blastocidia in branched chains appear in several leaf litter or wet habitat fungi such as *Cladosporium strumelloideum* Mil'ko & Dunaev (1986) described from a submerged *Carex* leaf, *Diploospora longispora* Matsushima (1975), or *Strumella uniseptata* Matsushima (1975). *C. strumelloideum* departs from *Cladosporium* because it lacks the typical, thickened detachment scars on conidia and conidiophores and is rather close to *Strumella macrospora* Matsushima (1975). *Strumella uniseptata* is more similar to our fungus, but *Strumella* Sacc. (non *Strumella* Fries) is a not well known genus, according to Hennebert (1968) similar to the aeroaquatic *Spirosphaera* van Beverwijk. *Diploospora longispora* also looks similar to *C. divergens*, but the type species *D. rosea* Grove is quite different. *Fusidium* Link might also accommodate our fungus, but like the others, it lacks the sympodial branching of conidial chains. Anyhow, these taxa are either not well known or differ from the commonly accepted concept of their genera. The sympodial mono- or dichasium-like arrangement of conidia in chains in our fungus is unique and therefore I feel justified to erect a new genus for it.

ACKNOWLEDGEMENT — Sincere thanks are due to Dr. E. Descals for reviewing the manuscript and for valuable comments and language corrections.

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## AGARICALES LIGNÍCOLAS SOBRE *EUCALYPTUS* EN EL N.W. DE ESPAÑA

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**RESUMEN** — Se mencionan 22 taxones lignícolas de Agaricales poco frecuentes recolectados sobre diversas especies de *Eucalyptus*, en el N.W. de la Península Ibérica. *Cuphophyllus grossulus* (Pers.) Bon, *Hohenbuehelia grisea* (Peck) Singer, *H. rickenii* (Kühner) P.D.Orton, *Marasmiellus omphaliformis* (Kühner) Noordel., *Mycena tenerrima* (Berk.) Quél. y *Psathyrella dicrani* (R.E.Jansen) Kits van Wav. son novedades para la Península Ibérica.

**RÉSUMÉ** — Les auteurs mentionnent 22 taxons lignicoles d'Agaricales rares récoltés sur diverses espèces d'*Eucalyptus* du N.W. d'Espagne. *Cuphophyllus grossulus* (Pers.) Bon, *Hohenbuehelia grisea* (Peck) Singer, *H. rickenii* (Kühner) P.D.Orton, *Marasmiellus omphaliformis* (Kühner) Noordel., *Mycena tenerrima* (Berk.) Quél. et *Psathyrella dicrani* (R.E.Jansen) Kits van Wav. sont taxons nouveaux pour la Peninsule Ibérique.

**MOTS CLEFS:** Agaricales, Chorologie, *Eucalyptus*, Écologie

**ABSTRACT** — We mention 22 lignicolous taxa of rare Agaricales, collected on some *Eucalyptus* species from N.W. of Spain. *Cuphophyllus grossulus* (Pers.) Bon, *Hohenbuehelia grisea* (Peck) Singer, *H. rickenii* (Kühner) P.D.Orton, *Marasmiellus omphaliformis* (Kühner) Noordel., *Mycena tenerrima* (Berk.) Quél. and *Psathyrella dicrani* (R.E.Jansen) Kits van Wav. are new taxons for Iberian Peninsula.

**KEYWORDS:** Agaricales, Chorology, *Eucalyptus*, Ecology.

## INTRODUCCIÓN

Las referencias micológicas a las plantaciones de eucalipto, en la Península Ibérica, son escasas (Sankaran et al. 1995), a pesar de que al género *Eucalyptus* pertenecen algunas de las especies forestales más cultivadas.

No es una excepción Galicia, una de las regiones españolas donde su cultivo es más intenso. Se ha repoblado mayoritariamente con *Eucalyptus globulus* Labill. (hasta un 95%) ocupando un total de 239.000 Ha. entre masa puras y mixtas y, en menor medida,

con *Eucalyptus camaldulensis* Dehnh., *E. viminalis* Labill., *E. delegatensis* R.T.Baker, *E. macarthuri* Deane & Maiden y *E. obliqua* L'Herit (Silva Pando & Rigueiro Rodríguez, 1992).

Con este estudio se pretende contribuir al mejor conocimiento de la micoflora de Agaricales lignícolas, recolectados sobre diversas especies de *Eucalyptus*. Para ello se han efectuado recolecciones en diversos puntos del N.W. de la Península Ibérica (mapa 1), desde 1992 hasta 1996, durante todo el año, aunque con mayor frecuencia desde el mes de octubre al de febrero.

Indicamos un total de 22 taxones nuevos o escasamente citados en España. Para cada uno de ellos figura la mención más próxima que conocemos, evaluando así la aportación corológica que supone nuestra recolección. Y, en las especies que se mencionan por primera vez incluimos una breve descripción personalizada.



Mapa 1. Situación de las provincias españolas y portuguesas mencionadas en el texto

## CATALOGO

### *Crepidotus calolepis* (Fr.) P. Karst.

Colecciones examinadas: Pontevedra: A Guarda, Camposancos, 29TNG1035, sobre corteza de *Eucalyptus globulus*, 4-XI-1995, leg. M. Lago & D. Solís, LOU-Fungi 1863.

Citado para la zona central y oriental de la Península Ibérica (Guinea, 1929; Malençon & Bertault, 1972).

***Crepidotus epibryus* (Fr.: Fr.) Quél.**

Colecciones examinadas: Pontevedra: A Guarda, Camposancos, 29TNG1035, sobre corteza de *Eucalyptus globulus*, 12-XII-1993, leg. M.I. López-Prada, LOU-Fungi 1548.

Resulta muy difícil determinar su corología en España, ya que puede confundirse con otras especies próximas (Moreno *et al.*, 1986).

***Cuphophyllus grossulus* (Pers.) Bon**

Píleo, estipe y láminas al principio blancas, después amarillentas. Esporas amigdaliformes, de  $6-8,8 \times 4-4,8$ . Se trata de la única especie de este género que vive sobre madera (Bon, 1989).

Colecciones examinadas: Pontevedra: Pontevedra, Ribeira do Lerez, 29TNG3098, sobre tocón de *Eucalyptus globulus*, 16-XI-1995, leg. M. Lago & D. Solís, LOU-Fungi 8468.

No hemos encontrado otras referencias para España.

***Hemimycena crispula* (Quél.) Singer**

Colecciones examinadas: Pontevedra: Vigo, A Guía, 29TNG2474, sobre corteza de *Eucalyptus globulus*, 6-I-1996, leg. M. Lago, LOU-Fungi 8590.

En España sólo encontramos referencias bibliográficas para Barcelona (Tabarés & Pascual, 1989)

***Hohenbuehelia grisea* (Peck) Singer**

Píleo pardo grisáceo, de 2,5-4 cm., subsésil. Cutícula afieltrada. Esporas amigdaliformes, de  $(4,8)-6,4-8,2 \times 3,2-4,8$   $\mu\text{m}$ . Queilocistidios metuloides, con ápices con incrustaciones, ventrudos, de  $38-56 \times 8,8-16,6$   $\mu\text{m}$ .

Colecciones examinadas: Pontevedra: Vigo, A Guía, 29TNG2474, sobre corteza de *Eucalyptus globulus*, 22-XI-1992, leg. M. Castro & M. Lago, LOU-Fungi 8418.

No hemos encontrado otras referencias para España.

***Hohenbuehelia rickenii* (Kühner) P.D.Orton**

Píleo pardo amarillento, margen lobulado, subsésil. Cutícula recubierta por un tomento blanco. Esporas elipsoides, de  $7,2-8-(8,8) \times 3,2-4,4$   $\mu\text{m}$ . Pleurocistidios abundantes, fusiformes, con incrustaciones en los ápices, con paredes muy gruesas metuloides, color pardo amarillento, de  $56-86 \times 8-18$   $\mu\text{m}$ .

Colecciones examinadas: A Coruña: Abegondo, Mabegondo, 29TNH5988, sobre *Eucalyptus globulus*, 3-XII-1988, leg. M. Castro, LOU-Fungi 4807.

No hemos encontrado otras referencias para España.

***Hohenbuehelia silvana* (Sacc.) O.K. Miller**

Colecciones examinadas: Pontevedra: A Guarda, Camposancos, 29TNG1035, 4-XI-1995, leg. M. Lago & D. Solís, LOU-Fungi 8341; Pontevedra, Ribeira do Lérez, 19TNG3098, 14-XII-1995, leg. M. Lago & D. Solís, LOU-Fungi 3328; Vigo, A Guía, 29TNG2478, 14-XI-1992, leg. M. Lago, LOU-Fungi 3766; idem, 12-IX-1994, LOU-Fungi 8342. Sobre cortezas y troncos podridos de *Eucalyptus globulus*.

Se trata de un taxon poco frecuente en el N.W. de la Península Ibérica, citada anteriormente para la provincia de Lugo por Castro Cerceda *et al.* (1995).

***Marasmiellus omphaliformis* (Kühner) Noordel.**

Pileo pardo grisáceo o pardo rosado, de 0,7-2 cm. de diámetro, infundibuliforme. Láminas grisáceas o rosadas. Pleurocistidios utriformes o lageniformes, de 9,6 µm. de ancho. Caulocistidios cilíndrico-fusiformes, subcapitados. Hifas del epicutis hinchadas y a menudo con pordes pigmentadas y terminaciones mucronadas o subcapitadas.

Colecciones examinadas: Pontevedra: A Guarda, Camposancos, 29TNG1035, sobre restos leñosos de *Eucalyptus globulus*, 4-XI-1995, leg. M. Lago & D. Solís, LOU-Fungi 3550.

Es un taxon poco frecuente en Europa (Antonín & Noordeloos, 1993) y del que no hemos encontrado referencias bibliográficas en España.

***Melanotus hepatochrous* (Berk.) Singer**

Colecciones examinadas: A Coruña: Ferrol, Doniños, 29TNJ5516, 26-II-1995, leg. C. Rodríguez & R. Rodríguez, LOU-Fungi 8373. Lugo: Becerreá, Liber, 29TPH6251, 3-X-1993, M. Lago & M. Castro, LOU-Fungi 5352. Ourense: Verín, Alto de Fumaces, 29TPG3445, 25-XII-1996, leg. M. Lago & A. Pardo, LOU-Fungi 9019. Pontevedra: Redondela, Rande, 29TNG2868, 8-XI-1993, leg. J. Rodríguez, LOU-Fungi 8371; Redondela, monte da Telleira, 29TNG3082, 18-XI-1995, leg. M. Lago & E. Luis, LOU-Fungi 3552; Vigo, Canido, 29TNG1670, 26-IV-1995, leg. M. Alonso & A. Alonso, LOU-Fungi 8370; Vigo, As Lagoas-Marcosende, 29TNG2768, 18-XI-1992, leg. M. Lago, LOU-Fungi 3798; idem, 10-IX-1993, LOU-Fungi 8374; idem, 12-IX-1994, leg. M. Lago & J. Rodríguez, LOU-Fungi 8372; Vigo, A Guía, 29TNG2478, 18-XI-1992, leg. M. Lago, LOU-Fungi 3798, 22-XI-1992, leg. M. Lago & M. Castro, LOU-Fungi 3551; idem, 9-X-1993, leg. M. Lago, LOU-Fungi 6993; idem, 12-IX-1994, LOU-Fungi 7077. Sobre madera y cortezas de *Eucalyptus camaldulensis* y *E. globulus*.

Mencionada con anterioridad para Europa por Watling & Gregory (1987) en Inglaterra y para el sur de España (Córdoba) por Esteve-Raventós *et al.* (1996).

***Mycena tenerrima* (Berk.) Quél.**

Pileo muy pequeño, de 2-4 mm. de diámetro, estriado por transparencia. Superficie viscosa, blanco furfurácea, centro gris. Láminas blanquecinas, con pseudocollarium. Queilocistidios claviformes, lageniformes o fusiformes, diverticulados y con base fibulada. Esporas amiloides, con grandes gúttulas, hialinas, de 7,6-10 × 4,8-6 µm.

Colecciones examinadas: A Coruña: Pobra do Caramiñal, Miserela, 29TNH0319, 6-II-1993, leg. M. Pérez-Froiz, LOU-Fungi 4265. Pontevedra: Pontevedra,

Ribeira do Lérez, 29TNG3098, 4-I-1996, leg. M. Lago & D. Solís, LOU-Fungi 8591. Sobre corteza de *Eucalyptus globulus*.

No hemos encontrado otras referencias para España.

***Pleuroflammula ragazziana* (Bres.) Horak**

Colecciones examinadas: Pontevedra: Nigrán, Monteferro, 29TNG1367, 16-XI-1991, leg. M. Castro & M. Martínez-Campos, LOU-Fungi 3553; Vigo, A Guía, 29TNG2478, 22-XI-1992, leg. M. Lago, LOU-Fungi 3797; idem, 22-XII-1992, LOU-Fungi 3822. Sobre *Eucalyptus globulus*.

Mencionada en Europa para Portugal (sobre eucalipto) y para Irlanda (sobre tilo) (Horak, 1978, 1987), para Francia (Heriveau & Courtecuisse, 1995) y, recientemente, en Lérida (España) por Vila *et al.* (1996).

***Pluteus nanus* (Pers.: Fr.) P. Kumm.**

Colecciones examinadas: A Coruña: Santiago, Reborido, 29TNH3347, 25-IX-1995, leg. M. Lago & E. Luis, LOU-Fungi 8385; Pontevedra: A Guarda, Camposancos, 29TNG1035, 4-XI-1995, leg. M. Lago & D. Solís, LOU-Fungi 3555; Pontevedra, Ribeira do Lérez, 29TNG3098, 23-XI-1995, leg. M. Lago, LOU-Fungi 3556; Vigo, Saiáns, 29TNG1668, 19-XI-1995, leg. M. Lago & E. Luis, LOU-Fungi 3557. Sobre madera podrida de *Eucalyptus globulus*.

Se trata de una novedad para el N.W. Ibérico, aunque ha sido citada con frecuencia para la zona oriental (Maire, 1937; Singer, 1947; Maublanc, 1936).

***Pluteus pellitus* (Pers.: Fr.) P. Kumm.**

Colecciones examinadas: Pontevedra: Redondela, Rande, 29TNG2868, sobre tocón de *Eucalyptus globulus*, 8-IV-1993, leg. J. Rodríguez, LOU-Fungi 8301.

En España, únicamente encontramos referencias bibliográficas en Barcelona (Tabarés & Rocabruna, 1987) y Vizcaya (Muñoz *et al.*, 1992).

***Pluteus phlebophorus* (Ditmar: Fr.) P. Kumm.**

Colecciones examinadas: A Coruña: Santiago, O Pedroso, 29TNH3549, sobre tocón de *Eucalyptus globulus*, 1-XI-1993, leg. M. Lago & L. Freire, LOU-Fungi 5868.

Sólo aparece mencionada para la zona oriental de la Península Ibérica (Maire, 1933; Heim, 1934; Malençon & Bertault, 1972).

***Pluteus podospileus* Sacc. & Cub.**

Colecciones examinadas: Pontevedra: Vigo, A Guía, 29TNG2478, sobre restos leñosos de *Eucalyptus globulus*, 17-IV-1993, leg. M. Lago, LOU-Fungi 4281; idem, 30-V-1993, LOU-Fungi 4282; idem, 11-X-1993, LOU-Fungi 6999.

Citada con anterioridad para la zona sur y oriental de la Península Ibérica (Maire, 1937; Moreno *et al.*, 1984).

***Pluteus umbrosus* (Pers.: Fr.) P. Kumm.**

Colecciones examinadas: Pontevedra: Vigo, A Guía, 29TNG2478, sobre restos leñosos de *Eucalyptus globulus*, 12-IX-1994, leg. M. Lago, LOU-Fungi 8360.

Publicada de forma imprecisa para el norte de la Península Ibérica por Moreno *et al.* (1986).

***Psathyrella conopilus* (Fr.: Fr.) Pears & Dennis**

Collections examined: Pontevedra: Pontevedra, Ribeira do Lérez, 29TNG3098, sobre restos leñosos de *Eucalyptus globulus*, 16-XI-1995, leg. M. Lago & D. Solís, LOU-Fungi 8569.

En España solamente ha sido recolectada en Barcelona por Mayoral & Ángel (1995).

***Psathyrella cotonea* (Quél.) Konrad & Maubl.**

Colecciones examinadas: Pontevedra: Redondela, Rande, 29TNG2868, sobre madera de *Eucalyptus globulus*, 13-III-1995, leg. J. Rodríguez, LOU-Fungi 8583.

En España ha sido previamente publicada para Barcelona por Rocabrúna & Tabarés (1991).

***Psathyrella dicrani* (A.E. Jansen) Kits van Wav.**

Pileo pardo rojizo, margen más pálido y estriado. Cutícula higrófana. Láminas con arista blanca. Pleurocistidios lageniformes, a veces curvados, de  $60\text{--}70 \times 14\text{--}18 \mu\text{m}$ . Queilocistidios esferopedunculados, claviformes o mucronados. Esporas adaxialmente aplanadas, de  $8,4\text{--}12,8 \times 4,8\text{--}5,6\text{--}(7,2) \mu\text{m}$ .

Colecciones examinadas: A Coruña: Ferrol, Doniños, 29TNJ5516, sobre restos leñosos y filodios de *Eucalyptus globulus*, 26-II-1995, leg. C. Rodríguez & R. Rodríguez, LOU-Fungi 8579.

No hemos encontrado referencias bibliográficas de esta especie para la Península Ibérica.

***Psathyrella pennata* (Fr.: Fr.) Konrad & Maubl.**

Colecciones examinadas: Pontevedra: Vigo, A Guía, 29TNG2478, sobre madera quemada de *Eucalyptus globulus*, 31-I-1993, leg. M. Lago, LOU-Fungi 8586.

Mencionada para España, en Barcelona por Faus (1981).

***Tubaria romagnesiana* Arnolds**

Se trata de una especie muy parecida a *Tubaria furfuracea* (Pers.: Fr.) Gillet, pero se diferencia por el hábitat lignícola y el rango esporal, de  $6,4\text{--}8,8 \times (4,4)\text{--}4,8\text{--}5,6 \mu\text{m}$ .

Colecciones examinadas: A Coruña: Santiago, O Pedroso, 29TNH3549, sobre tronco de *Eucalyptus globulus*, 15-IX-1994, leg. M. Lago, LOU-Fungi 430.

No se puede precisar su distribución para la Península por citarse habitualmente incluida en el grupo de *Tubaria furfuracea* s. lato.



### *Volvariella caesiotincta* P.D. Orton

Colecciones examinadas: Pontevedra: Vigo, A Guía, 29TNG2478, sobre madera de *Eucalyptus globulus*, 11-XI-1992, leg. J. Fernández Pérez, LOU-Fungi 7000; idem, 29-XI-1992, M. Lago, LOU-Fungi 3010.

Para España ha sido mencionada en Barcelona por Tabarés & Rocabrunga (1987).

### AGRADECIMIENTOS

Nuestro agradecimiento al Dr. Esteve-Raventós por su ayuda en la revisión de citas bibliográficas para la Península Ibérica y a los Dres. Bon y Horak por la supervisión de algunas identificaciones.

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## OCCURRENCE OF *ARMILLARIA ECTYPA* (Fr.) Lamoure IN PEAT BOGS OF THE AUVERGNE — THE REPRODUCTION SYSTEM OF THE SPECIES

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**SUMMARY** — *Armillaria ectypa* (Fr.) Lamoure is regarded as the only *Armillaria* species throughout the world which is not linked to trees or shrubs. This rare species is found in the arctic or mountain peat-bogs of Europe.

A survey of the macromycetes of the peat bogs was carried out in the Auvergne region (Central France). *Armillaria ectypa* was discovered in seven sites, it was particularly abundant (over 100 fruitbodies) in one of them.

The morphology of the fruitbodies and mycelium in culture is described. Previous studies suggested for the species a homothallic system of reproduction. This was confirmed by: i) the morphological similarity of the single-spore isolates from one fruiting body, ii) the absence of mating reactions among these isolates when paired and iii) the similarity of these single spores through RAPD analysis. By contrast, RAPD revealed variability among single-spore mycelia isolated from the fruitbody of a tetrapolar species (*Armillaria ostoyae*).

**KEY WORDS:** *Armillaria*, Basidiomycetes, peat bogs, ecology, RAPD markers, homothallism.

**RÉSUMÉ** — *Armillaria ectypa* (Fr.) Lamoure est la seule espèce d'armillaire connue qui ne soit pas lignivore et liée aux écosystèmes ligneux. Cette espèce, qui passe pour très rare, est inféodée aux sphaignes, sa présence a été signalée d'une part en Laponie, d'autre part dans les tourbières de montagne de l'Europe tempérée.

Une prospection des Macromycètes des tourbières de la Région Auvergne a conduit à la découverte d'*A. ectypa* sur 7 sites d'Auvergne (5 dans le Puy-de-Dôme, un en Haute-Loire, un dans le nord-est du Cantal). Son abondance était particulièrement grande (plus de 100 carpophores dénombrés) sur le site cantalien.

La présente publication décrit les carpophores de l'espèce sur ses stations auvergnates, ainsi que la morphologie du mycélium en culture.

Des travaux antérieurs suggéraient pour *A. ectypa* un système sexuel homothalle. De fait, les mycéliums monosporiques obtenus à partir d'un même carpophore sont apparus morphologiquement identiques et leur croisement n'a pas permis de les répartir en plusieurs pôles. L'analyse par RAPD d'une série de 10 monospores issues d'un même carpophore a confirmé l'homogénéité génétique de ces mycéliums. *A contrario*, l'analyse RAPD appliquée aux mycéliums monospores d'une armillaire hétérothalle (*A. ostoyae*) a fait apparaître une importante variabilité.

MOTS-CLÉS: *Armillaria*, Basidiomycètes, tourbières, écologie, marquage par RAPD, homothallisme.

## INTRODUCTION

*Armillaria ectypa* (Fr.) Lamoure is a rare European agaric species specifically growing in peat bogs. This species was created by Fries (*Epichrisis Systematis Mycologici* 1836-1838) under the name *Agaricus ectypus*. Quélet (1881) transferred it to genus *Clitocybe* (Fr.) P. Kumm. Bresadola (1928) also described a fungus named *Clitocybe ectypa*, however according to Moreau & Moreau's analysis (1929), Bresadola's fungus was not the same species as that described by Fries. Lamoure (1965) observed the close taxonomical proximity between *Clitocybe ectypa sensu* Quélet and the forest species *Armillaria tabescens* (Scop.: Fr.) Emel, that earlier authors regarded as a *Clitocybe* species (*Clitocybe tabescens* (Scop.: Fr.) Bres.). *Armillaria tabescens* itself is related to the "true" *Armillaria* species (with annulate stipes) which constitute the complex "*A. mellea sensu lato*" (divided into a number of different species after the studies by Romagnesi (1970, 1973) and Korhonen (1978). *Armillaria ectypa*, *A. tabescens* and "*A. mellea sensu lato*" share three remarkable traits: initiation of highly-differentiated rhizomorphs in pure culture, bioluminescence of aerial mycelium, and the uninucleate state of the mycelial elements (Lamoure, 1965); beyond a doubt, these common features justify Lamoure's proposal to transfer *Clitocybe ectypa* to genus *Armillaria* (Fr.) P. Kumm. However, this species is unique within the genus by virtue of its ecology: in contrast with all the other *Armillaria* species, which are lignicolous and more or less pathogenic to living trees, *A. ectypa* has only been found in peat-bogs, associated with *Sphagnum*.

The species could also be original by its reproduction system. All the forest, European, *Armillaria* species have been shown to be heterothallic and tetrapolar (Hintikka, 1973; Korhonen, 1978; Guillaumin *et al.*, 1991). By contrast, Guillaumin (1973) suggested for *A. ectypa* a homothallic system of sexual reproduction; this suggestion was based on the morphological identity of the single spore cultures from the same fruitbody, the absence of mating reactions in pairings between these cultures, and formation of fertile fruitbodies in the laboratory from some of these strains of single-spore origin.

*Armillaria ectypa* has been found in two European areas: Lapland and the mountains of Western Europe. In Lapland, it was recently reported by Ohenoja & Väre (1993). In Western Europe, the species was reported from the Vosges (Quélet, 1881), Schwartzwald (Ohenoja, pers.comm.), Jura (Favre, 1939), the French Alps (Favre, 1939; Lamoure, 1965), the Bavarian Alps (Marxmüller, pers. comm.) and from two peat bogs of the Auvergne (Moreau & Moreau, 1929).

## MATERIAL AND METHODS

### 1) Mycological survey of the peat-bogs of the Auvergne

A mycological survey of the mountain peat-bogs of the Auvergne region has been conducted by one of the current authors (René-Jacques Bouteville). This survey concerned three of the four departments of the region (Puy-de-Dôme, Cantal, Haute-Loire), but was particularly intensive in the south-west area of the Department of Puy-de-Dôme (Monts-Dore, Artense and Cézallier). This survey reported a number of macromycetes (Bouteville, 1991), among which *Armillaria ectypa* was found.

### 2) Fungal material

Fruitbodies of *A. ectypa* were collected on 2 sites:

- a) the peat-bog of Limagne (Département: Haute-Loire, commune: Siaugues-Saint-Romain).
- b) the peat-bog of La Chambe (Département du Cantal, commune: Montgreleix).

Pure cultures of the fungus were obtained from these fruitbodies: a) from the sterile parts of the basidiome (stipe and context of the pileus), b) from single basidiospore isolation. The method used for single spore isolation has been previously described (Guillaumin & Berthelay, 1981).

As a control in RAPD studies, we also used single spore cultures of a tetrapolar species: *Armillaria ostoyae* (Romagnesi) Herink.: eight single-spore mycelia were isolated from a basidiome obtained in pure culture. The isolate which had fruited (number PC 79-4 in our collection) had been isolated in 1979 from a diseased Maritime pine (*Pinus pinaster*) at Cestas (Département de la Gironde).

### 3) Matings

The matings between single-spore cultures were carried out in Petri dishes on malt-agar (malt 2%, agar 1.5%). Inoculum for pairing consisted of undifferentiated mycelium cut from the margin of a growing culture. According to our routine procedures, the two plugs were placed side by side at the centre of the dish.

### 4) RAPD (Random Amplification of Polymorphic DNA)

#### a) culture of the fungus

The fungal strains were grown in liquid malt (2%) in plastic flasks at 23°C. The mycelium and rhizomorphs were collected after one month and lyophilised.

#### b) DNA extraction

Total DNA was extracted according to the method described by Mohammed (1994), slightly modified: each lyophilised sample (about 10-20 mg) was put in an Eppendorf tube of 1.5 ml with 500 µl of TES Buffer (100 mM Tris pH 8.0, 10 mM EDTA, 2% SDS). The sample was ground with sterile sand. Then, 5 µl proteinase K were added

(20 µg/ml) and the sample was incubated for 1 h at 55-60°C. Then, 100 µl of CTAB 10%-NaCl were added (CTAB 10g., NaCl 4,1 g., water qsp 100 ml). After an incubation of 10 min at 65°C, ADN was extracted with 700 µl of a mixture chloroform / isoamyl alcohol (24/1)-SEVAG.

After 30 min at -20°C., 10 min centrifugation at 13500 rpm led to separation into two phases, the upper, aqueous phase was transferred to a new Eppendorf tube, DNA was precipitated with 500 µl of isopropanol at -20°C., then concentrated by another centrifugation (20 min at 13500 rpm). The supernatant was removed and the pellet was rinsed twice with 1 ml of ethanol 70% at -20°C, dried and dissolved in 50 µl TE buffer.

The optical density of each sample was measured with a spectrophotometer at wavelength 260 nm. The samples ready for RAPD analysis were prepared by dilution so as to obtain about 60 ng of DNA in each test tube.

### c) RAPD test

The amplification reaction was conducted according to Williams *et al.* (1990), with slight modifications, in a volume of 25 µl with: 10 mM Tris-HCl pH 9, 50 mM KCl, 1.5 mM MgCl<sub>2</sub>, 0.1% Triton X100, 0.2% gelatin, 200 µM each of dATP, dTTP, dCTP, dGTP, 0.2 µM of the primer, 0.5 unit of Taq-polymerase (Appligène) and about 60 ng of DNA.

Amplification was carried out in a 9600 Perkin Elmer Cetus thermal cycler as follows: initial denaturation for 5 min at 93°C, then 40 cycles with the three steps: denaturation 1 min at 91°C, annealing 1 min at 36°C, polymerisation, 2 min at 70°C. The 40 cycles were followed by final extension for 5 min at 70°C.

The amplification products were separated by electrophoresis on 1.4% agarose gel in Tris-acetic-acid EDTA (TAE) buffer and detected by staining with ethidium bromide.

Five different primers were tried: three had been selected by Anderson's team at the University of Toronto: R25 (ACTTGAGGCG), R28 (ATGGATCCGC) and UBC31 (CCGGCCTTCC). These three primers had been shown to reveal a high variability among the isolates of *Armillaria* spp. (Smith *et al.*, 1992, Guillaumin *et al.*, 1996). The other two primers were OPD 20 (ACCCGGTCAC) and OPF 01 (ACGGATCCTG), produced by Operon Technologies, California, (kits D and F), and which had provided with good results at Clermont-Ferrand when applied to *Armillaria* isolates of African origin. (Abomo-Ndong *et al.* 1997).

## RESULTS

### 1) Distribution of *A. ectypa*

The species was found in seven sites of region Auvergne:  
Département HAUTE-LOIRE:

- \* peat-bog of Limagne (commune: Siaugues-Saint-Romain, altitude: 1083 m).

Département PUY-DE-DOME:

- \* peat-bog of Bourdouze (commune: Besse-et-Saint-Anastaise, alt.: 1210 m).
- \* " of Chambedaze (commune: Egliseneuve d'Entraigues, alt.: 1180m).
- \* " of La Godivelle d'en-Bas (commune: La Godivelle, alt.: 1200 m.)

- \* “ of Les Chastelets (commune: La Godivelle, alt.: 1208 m).
- \* “ of Rimat (commune: Chastreix, alt.: 1237 m.)

#### Département CANTAL:

\* peat-bog of la Chambe (commune: Montgreleix, alt.: 1210m.). This small peat-bog (fig.1) has no name on the maps, we named it from the name of the nearest “buron” (cattle shed).

With the exception of Limagne, located in the region Deves, these sites belong to the geographical region Cézallier-Artense, on the borders of Cantal and Puy-de-Dôme. These peat-bogs fill hollows due either to volcanic activity or to overdeepening by glaciers.



Figure 1 — General aspect of the peat-bog of La Chambe (with “Massif du Sancy” as a background).  
Figure 1 — Vue d'ensemble de la toubière de La Chambe (avec le Massif du Sancy en arrière plan).

#### 2) Ecological environment of the species

The number of basidiomes of *A. ectypa* found in 1996 was about 100 at La Chambe, 20 at Limagne, but <10 on the other five sites. The basidiomes of the fungus generally appear in late August. At La Chambe in 1996, the fruiting period extended from 15th August to 8th September.

The base of the vegetation of the bog consists of several species of *Sphagnum* (*S. subsecundum* ssp. *inundatum*, *S. platyphyllum*, *S. flexuosum*) which are partly flooded and constitute a spongy cloth more or less continuous. The angiosperms are typical of a

sphagnophilous vegetation (*Molinia coerulea*, *Carex* spp., *Eriophorum angustifolium*, *Potentilla palustris*, *Menyanthes trifoliata*, *Succisa pratensis*, *Drosera rotundifolia*, *Andromeda polifolia*, etc.). The basidiomes of *A. ectypa* appear either disseminated or by groups of 3-4 (fig.2), their stipe is attached to the lower, dead part of the sphagnum through a cottony aggregated mycelium. Rhizomorphs are not found in nature.

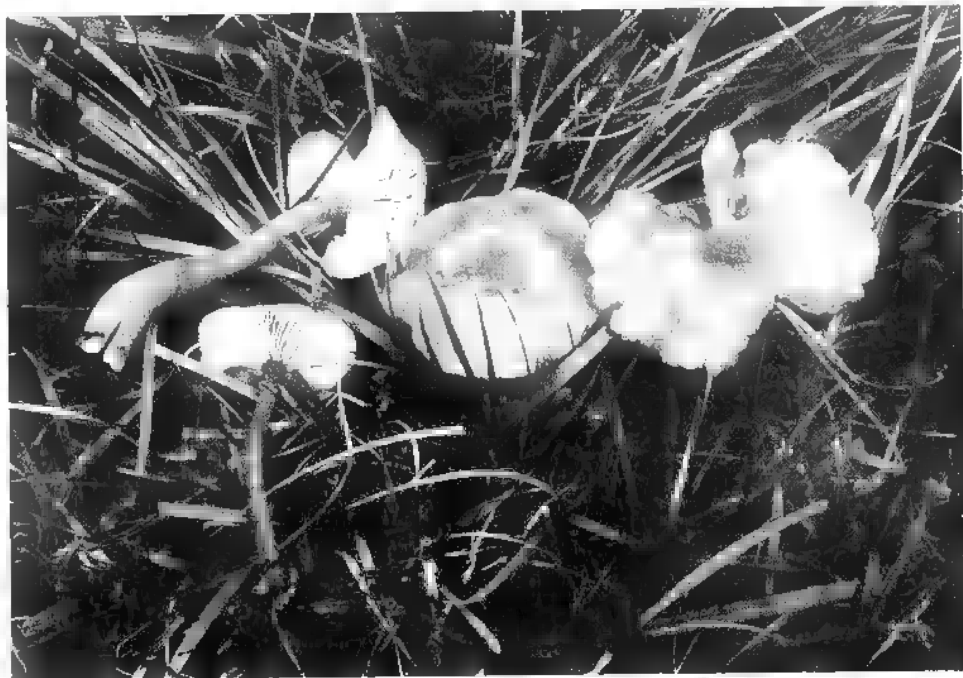


Figure 2 — Fruiting bodies of *A. ectypa* *in situ* (La Chambe).

Figure 2 — Fructification de *A. ectypa* *in situ* (La Chambe)

### 3) Morphology of the species

#### a) Fruitbodies in natural conditions (fig. 2-3)

The great number of basidiomes found at La Chambe led to observe some variations from the descriptions carried out by Moreau & Moreau (1929) and by Favre (1939).

The young **pileus** is convex, it becomes more flat when growing old, with an incurved or upturned margin. This pileus is frequently hygrophanous or water-soaked. The pileal surface is striate-pellucid, glabrous, glossy. A hand-lens is necessary to detect thin, radiating fibrils which are denser on the central disk. In dry weather, the dense central fibrils can peel off, giving a furfuraceous aspect to this part of the pileus which has often been decribed as glabrous.



The colour of the pileus is russet to brownish, imbued (S202-S203). In dry weather, it becomes paler (beige-ochraceous to sandy) from the centre to the margin, the colour of the central disk remaining darker.

The **lamellae** are scarce, more or less bulging, adnexed to slightly decurrent, in the latter case shortly prolonged on the stipe, more or less bifurcated at the insertion. The edge is smooth, irregular, first whitish then cream, finally brownish, like the margin of the pileus.

The **stipe** is long (10 to 12 cm), but deeply sunken in sphagnum, thin under the pileus (0.5 to 0.8 cm) but wider at the base, hollow. It is fibrillose or silky with brownish fibrils, which protrude over a paler background, soaked and sharing the same colour as the pileus. The stipe is pruinose below the hymenium (2 cm) and cottony at the base.



Figure 3 — Fruiting bodies of *A. ectypa* from Limagne

Figure 3 — Fructification de *A. ectypa* de Limagne

The **context** is entirely brownish, however its colour is highly variable according to the wetness of the basidiome. The smell is strong, acidic, recalling both vinegar and anise (as that of the sphagnum). It becomes foetid and unpleasant in dry samples. The taste is mild, slightly astringent after chewing.

The **basidiospores** are smooth, hyaline, ellipsoid, their dimensions are the same as for *A. mellea* or *A. ostoyae* ( $7-10 \times 5-6.5 \mu\text{m}$ ). Spore-print is cream-coloured.

*Armillaria ectypa* differs from the other exannulate *Armillaria* species *A. tabescens* by the woody habitat of the latter species (generally on oaks or chesnut) , its fasciculate basidiomes, its whitish context and its densely flecked pileus.

*Armillaria ectypa* fruits easily in the laboratory (fig.4).

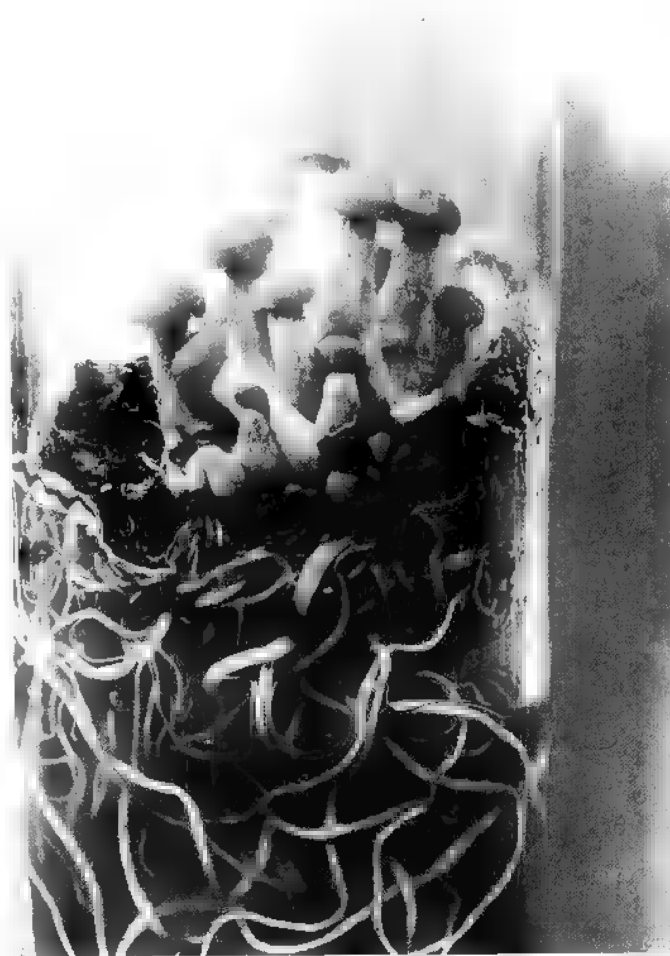


Figure 4 — Fruiting of *A. ectypa* in the laboratory (Isolate PY 72-2 from the French Alps).

Figure 4 — Fructifications de *A. ectypa* obtenues au laboratoire (Isolat PY 72-2 des Alpes françaises).

#### b) Aspect of the mycelia in pure culture

The morphology of *A. ectypa* in pure culture in standard conditions (culture at 24° in the dark, on malt 2%, agar 1.5%, in Petri dishes 9 cm in diameter) is typical (fig. 5-6). The single spore cultures and the cultures from the context of the basidiome are identical. The fungus grows more quickly than most other *Armillaria* species, it shows an abundant,

white aerial mycelium with a strong luminescence. After about 20 days, this mycelium is in places covered by discontinuous brown crusts. The rhizomorphs are abundant, sinuous, moderately branched, strictly cylindrical (diameter: 1-2 mm), they remain white even aged. They are generally intramatricial but can also protrude outside the medium. These rhizomorphs adhere to the bottom of the dish by special short brown, cylindrical, branches (fig. 7).

This morphology is typical of the species. By the white, abundant aerial mycelium and discontinuous crusts, *A. ectypa* resembles *A. mellea* and *A. tabescens*, but these two species have flattened, highly branched, rhizomorphs on malt 2%. On the other hand, *A. gallica* and *A. cepistipes* have, like *A. ectypa*, cylindrical rhizomorphs on malt 2%, but in the first two species, these structures are straight and become dark in old cultures. The adhering rhizomorphic branches also appear to be original structures. Guillaumin *et al.* (1990, unpublished) had included two isolates of *A. ectypa* (from the Auvergne and Bavaria) in a morphological comparison between 58 *Armillaria* isolates. The use of Factorial Analysis of Correspondances had shown that the two isolates of *A. ectypa* appeared very close to each other and far from the other species.

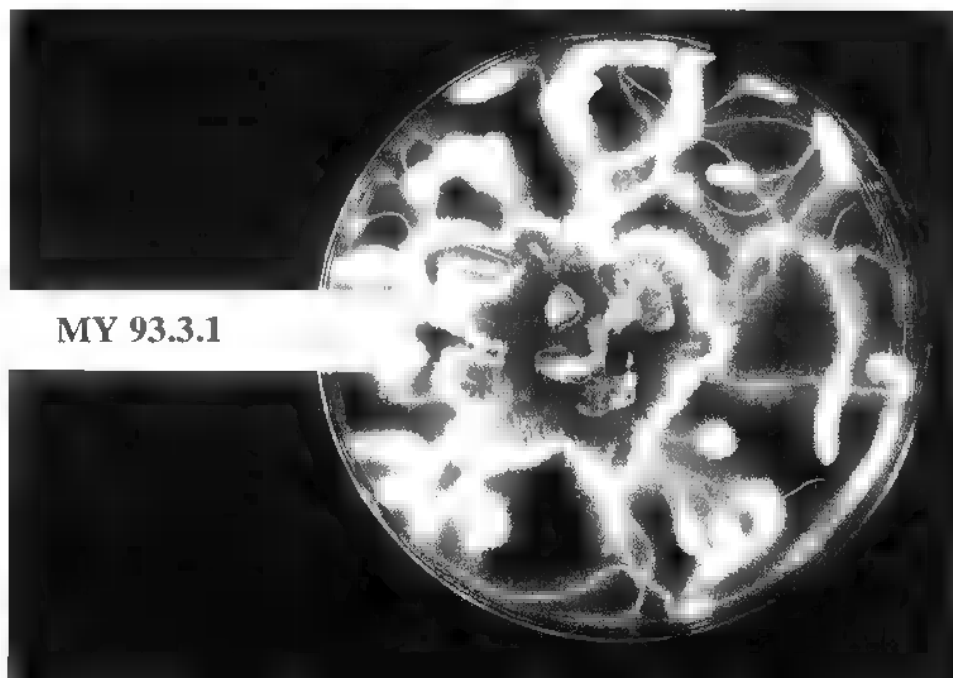


Figure 5 — Mycelium of *A. ectypa* (single-spore isolate MY 93.3.1 from Limagne) aged three weeks: upper side of the Petri dish

Figure 5 — Mycélium de *A. ectypa* (culture monosporale de l'isolat MY 93.31 de Limagne) âgé de trois semaines : face supérieure de la boîte de Petri.

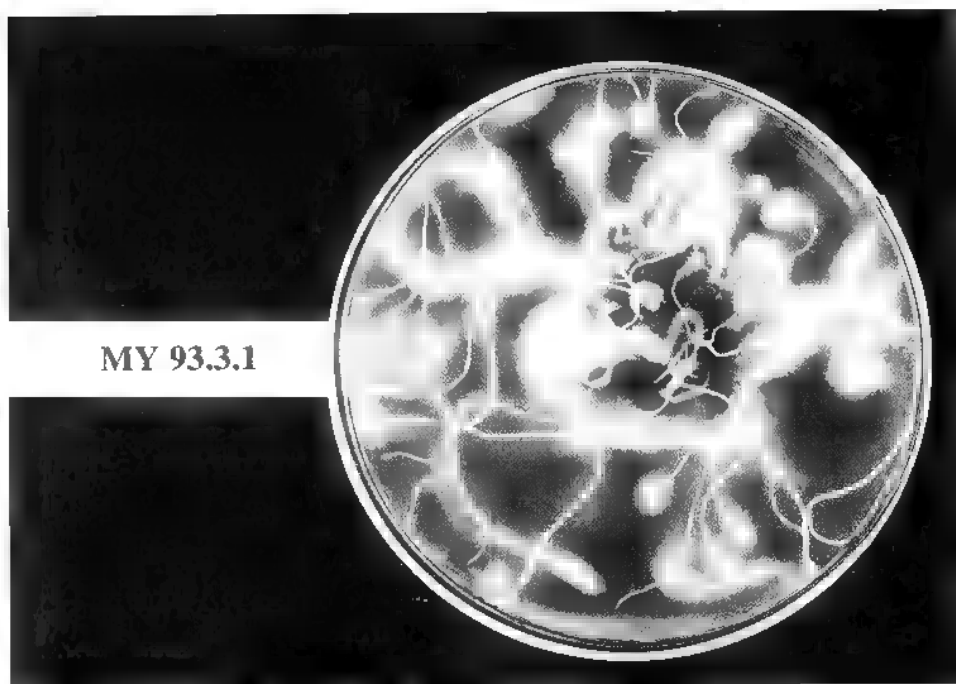


Figure 6 — id., lower side of the Petri dish.

Figure 6 — id., face inférieure de la boîte de Petri.

### 3) Matings

- a) 8 single-spore mycelia from a basidiome from Limagne were paired with each other (total:  $C8/2 = 28$  pairings).
- b) 10 single-spore mycelia from a basidiome from the peatbog of La Chambe were also paired with each other (total:  $C10/2 = 45$  pairings).
- c) 3 single-spore cultures from Limagne were then paired with 3 single-spore cultures from La Chambe (9 pairings).

No mating behaviour could be observed from any of these 82 pairings. The different strains, which were morphologically very similar (even from the two different sites) seemed to fuse with each other without any morphological modification of the mycelia or incompatibility reactions. After 1 month, in most cases it was impossible to distinguish between the thalli of the two paired strains.

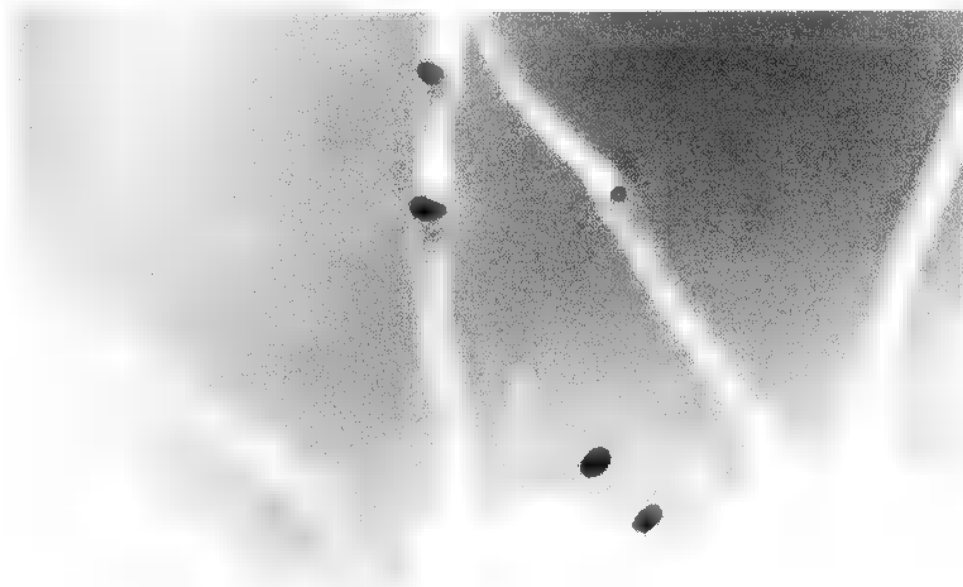


Figure 7 — Rhizomorphs in culture with adhesive branches.

Figure 7 — Rhizomorphes en culture avec ramifications adhésives.

#### 4) RAPD

\* In a first step, 10 single spore cultures of *A. ectypa* from La Chambe were investigated with primer UBC31 in comparaison with 8 single-spores of *A. ostoyae* originating from a fruitbody of the isolate PC 79-4.

The ten single-spore cultures of *A. ectypa* from the same fruitbody appeared completely identical, all exhibiting 9 bands at the same rF. By contrast, an important variability appeared among the single-spore cultures of *A. ostoyae*: 11 potential major bands were found for the eight strains as a whole, of which 4 were common to all 8 strains. From the other 7 major bands, only two strains appeared similar (n° 3 and 8), all the others were different from each other:

PC 79-4-1	: bands 1, 3, 6,7,8,9,10,11
PC 79-4-3	: bands 3,4,5,6,7, 9,10,11
PC 79-4-4	: bands 2,3,4, 6,7, 9,10,11
PC 79-4-5	: bands 2,3, 6,7,8,9,10,11
PC 79-4-6	: bands 4,5,6,7, 10,11
PC 79-4-8	: bands 3,4,5,6,7, 9,10,11
PC 79-4-9	: bands 2, 5,6,7, 10,11
PC 79-4-10	: bands 3,4,5,6,7,8,9,10,11

\* In a second step, only five single spores of *A. ectypa* were analysed, with, as a heterothallic control, only four single spores of *A. ostoyae* (numbers PC 79-4-3, 5, 8 and 9). Four different primers were tried: R25, R28, OPD20 and OPF01.

— with R25 (fig.8), the five single-spores of *A. ectypa* were identical, with five major and five minor bands. The four single-spores of *A. ostoyae*, had, as a whole, 9 potential major bands, and numbers 5 and 8 were identical:

PC 79-4-3 : bands 1,2, 4, 6,7,8,9  
 PC 79-4-5 and 8 : bands 2,3,4, 6,7,8,9  
 PC 79-4-9 : bands 1,2, 4,5, 7,8,9

— with R28, the five single-spores of *A. ectypa* were identical, all of them showing 8 major bands at the same rF. The four single-spores of *A. ostoyae* had, as a whole, 7 major bands and were easily differentiated from each other:

PC 79-4-3 : bands 2, 5, 7,  
 PC 79-4-5 : bands 2, 5,6,7  
 PC 79-4-8 : bands 2, 4,5  
 PC 79-4-9 : bands 1,2,3, 5,6

— with OPD20 (fig.8), the five single-spores of *A. ectypa* were identical, with only 1 major band and some 10 minor bands. The four single-spores of *A. ostoyae* had only five major bands, and could however be differentiated from each other:

PC 79-4-3 : bands 1, 3, 5  
 PC 79-4-5 : bands 1, 3,4,5  
 PC 79-4-8 : bands 1,2,3,4,5  
 PC 79-4-9 : bands 1,2,3, 5

— with OPF01, the five single-spores of *A. ectypa* were identical, all of them showing 1 major and 5 minor bands at the same rF. As concerned *A. ostoyae*, the DNA of the mycelium of PC 79-4-5 had not been amplified. The numbers 3 and 9 appeared similar (3 major bands at the same rF) and the number 8 was different, with one of the three bands lacking.

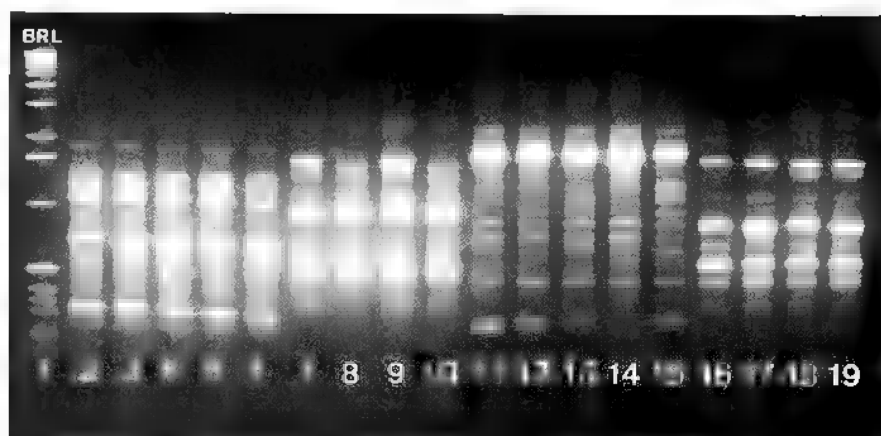


Figure 8 — RAPD analysis of single spores of *A. ectypa* and *A. ostoyae* : lanes 2-6: *A. ectypa*, primer R25; lanes 7-10: *A. ostoyae*, primer R25; lanes 11-15: *A. ectypa*, primer OPD 20; lanes 16-19: *A. ostoyae*, primer OPD 20.

Figure 8 — Analyse en RAPD de souches monosporiques de *A. ectypa* et *A. ostoyae*: 2-6: *A. ectypa*, primer R25; 7-10: *A. ostoyae*, primer R25; 11-15: *A. ectypa*, primer OPD 20; 16-19: *A. ostoyae*, primer OPD 20.

## DISCUSSION AND CONCLUSION

*Armillaria ectypa* seems to be a strictly European, arctico-alpine species. Perhaps a relict of the ice age, it is confined to *Sphagnum* peatbogs of high latitude or altitude. Even in Lapland, it is not a common species and seems to be declining (Ohenoja & Väre, 1993). It is quite rare in the mountains of temperate Europe where, to our knowledge, it has not still been reported from massifs such as the Pyrénées or the Carpathians. However, our study shows that it is particularly frequent in the Cézallier, a volcanic plateau of the Massif Central at altitude 1100-1300 m., which has been restructured by quaternary glaciations. The Cézallier harbours several angiosperms which are relicts from the ice age, for instance the very rare Asteraceae *Ligularia sibirica*, which is abundant at Les Chastelets where it coexists with *A. ectypa*.

In contrast to several forest *Armillaria* species, highly pathogenic for trees, *A. ectypa* has no economic importance. However, this species is interesting from two points of view: its phylogenetic relationships with the forest *Armillaria* species and its reproduction system.

A recent study based on ITS sequencing (Chillali *et al.*, 1997), shows that *A. ectypa* is genetically more distant from all the other European *Armillaria* species (including *A. tabescens*) than these species are from one another. In 1979, Lung-Escarmant and Dunez, using immunoenzymatic methods, had drawn similar conclusions. It is likely that a common ancestor of all the forest *Armillaria* species (maybe close to *A. tabescens*) has early diverged from a peat-bog species. The former would have given rise to a number of wood-colonizing saprophytic or parasitic species while the latter, confined in the particular environment of the peat-bogs, would have remained more or less stable.

The caryological cycle and reproduction system are other original traits of the species. *Armillaria ectypa* is certainly homothallic. The fruiting capacities of single-spore isolates (Guillaumin, 1973), absence of mating reactions, morphological identity between single-spore mycelia and isolates from the context of the basidiome, were good arguments which are strengthened by the demonstration, given by the present study, of genetical identity of the single-spore isolates from the same basidiome. The basidia have regularly four spores, the basidiospores are uninucleate, a normal meiosis seems to occur in the basidium (Guillaumin, unpublished). Therefore, the hypothesis of primary homothallism can be proposed in preference to secondary homothallism or apomixy. The mycelium would be diploid, as in the other *Armillaria* species, the basidiospores would be haploid, and a self-diploidization would take place in the early stages of the growth of the mycelium, maybe during germination of the basidiospore. However, this self-diploidization remains completely hypothetical and needs confirmation by cytological observations of young germinations.

Recent studies have revealed that other *Armillaria* species have a homothallic reproduction system: *A. mellea* ssp. *africana*, *A. mellea* ssp. *nipponica*, the Caribbean species *A. puiggarii* Speg. and certain isolates of the African species *A. heimii* Pegler (Mohammed & Guillaumin, 1993; Cha & Igarashi, 1995; Abomo-Ndongo *et al.*, 1997). Except *A. mellea* ssp. *nipponica*, these species are tropical. Like *A. ectypa*, they are suspected of having a diploid cycle and an early self-diploidization in the mycelium. However, these taxa differ from *A. ectypa* by the absence of dikaryons and clamps in the hymenium. By contrast, *A. ectypa* is regularly clamped in the subhymenium (Lamoure, 1965; Guillaumin, 1973). By this characteristic, it resembles some heterothallic species

like *A. ostoyae* (Romagn.) Herink, *A. gallica* Marxmüller & Romagn. or *A. borealis* Marxmüller & Korhonen. On the other hand, the tropical homothallic species are similar to an other group of temperate, heterothallic species including *A. mellea* ssp. *mellea* and all the Australian *Armillaria* species, which all lack clamp connexions in the hymenium. The origin of these transitory clamped elements is not really understood, even in the context of heterothallism; they suppose a vegetative haploidization in the young basidiome.

An additional characteristic of *A. ectypa* is the absence, in this species, of the phenomenon of intraspecific Somatic Incompatibility (SI): the pairing of isolates from different geographical origins results in merging of mycelia without any antagonistic reaction. *A. ectypa* shares this behaviour with the African, partly homothallic species *A. heimii* (Abomo-Ndongo Guillaumin, 1997) but differs from all the tetrapolar, temperate *Armillaria* species in which intraspecific SI is a general and very spectacular phenomenon (Guillaumin *et al.*, 1991). The biological consequence of SI in these tetrapolar species is the vegetative isolation of the different genotypes or "genets" (Legrand *et al.*, 1996), which can exchange genes through sexual reproduction, but not through vegetative anastomoses; thus, heterokaryosis is strongly limited in these species. The absence of SI in *A. ectypa* could have two explanations: (i) either the species consists of one and the same clone at least in all the European mountains (the pairing with arctic isolates has not been attempted yet), (ii) or the different genotypes can exchange nuclei without any obstacle, leading to general heterokaryosis within the species. The analysis of variability between isolates of different geographical origins (for instance with the tools of RAPD) should allow a choice between the two hypotheses.

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## TAXONOMIC STATUS OF *DIDYMIUM LAXIFOLIUM* AND *D. RUBEOPUS*, INCL. A NEW VARIETY OF *D. RUBEOPUS* (MYXOMYCETES).

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**ABSTRACT** — *Didymium rubeopus* is described, together with the new variety *D. rubeopus* var. *albocapillitium*. It is compared with the similar *D. laxifilum*, for which a lectotype is proposed. LM and SEM microphotographs illustrate the more representative characters.

**KEY WORDS** — *Didymium laxifilum*, *D. rubeopus*, *D. rubeopus* var. *albocapillitium*, Myxomycetes, taxonomy.

**RESUMEN** — Se describe *Didymium rubeopus* y la nueva variedad *D. rubeopus* var. *albocapillitium*. Se compara con la especie próxima *D. laxifilum* de la que se propone un lectotipo. Se aportan microfotografías de M.O. y MEB de sus características morfológicas más representativas.

**PALABRA CLAVAS** — *Didymium laxifilum*, *D. rubeopus*, *D. rubeopus* var. *albocapillitium*, Myxomycetes, taxonomy.

**RÉSUMÉ** — On décrit *Didymium rubeopus* et la nouvelle variété *D. rubeopus* var. *albocapillitium*. On compare avec une espèce proche *Didymium laxifilum* de laquelle on propose un lectotypus. On propose des microphotographies au MO et au SEM de leurs caractéristiques morphologiques les plus représentatives.

**MOTS-CLEFS** — *Didymium laxifilum*, *D. rubeopus*, *D. rubeopus* var. *albocapillitium*, Myxomycetes, taxonomie.

### INTRODUCTION

*Didymium laxifilum* was described by Gulielma Lister and Joseph Ross (Lister, 1945) from abundant material collected in Epping Forest near the Warren, Loughton (Sussex, England) on leaves of beech and bramble. The first collection was made by Ross in February, 1935, who found it to be generally plentiful in Epping Forest and adjacent

areas in the autumn of 1943. G. Lister and J. Ross also examined further gatherings collected by Mr. W.D. Graddon near Woodford Wells (in the Waltham Forest district of North London and ca. 3 km south of the Epping Forest locality). However, despite the abundance of collected material, no type was indicated with the original diagnosis.

Kowalski (1973), during a visit to the Royal Botanic Gardens, Kew (England), examined a collection labelled as: *Didymium laxifilum* G. Lister & Ross, Ross 3501, Loughton, Epping Forest (Sussex, England). According to Kowalski, this is apparently the type collection.

In 1993, Mr. J.R. Garcia sent us some collections of an apparent *Didymium laxifilum*, found on leaves of *Quercus ilex*, in the Spanish provinces of Badajoz and Córdoba. With the object of comparing these samples with authentic *D. laxifilum* we applied to the Kew Herbarium for loan of the material determined by G. Lister, and, in particular, the collection 3501 studied for Kowalski, which is proposed for us as the lectotype.

After comparing the type material of *Didymium laxifilum* with the Spanish collections, we decided that both had different characters, which stimulated us to propose it as a new species for science. The new taxon (*D. rubeopus*) was validly published in the Abstracts of 2nd. Intern. Syst. Ecol. Myxomycetes (Moreno & al., 1996). Subsequently, we were able to study additional material of *D. rubeopus* from various localities in Spain, France and Mexico, which we found to be differentiated by their capillitium, which has lead us to propose a new variety of the latter taxon. Included are the original Latin diagnoses of *Didymium laxifilum* and *D. rubeopus*, which were published in journals which may be difficult to obtain.

## MATERIAL AND METHODS

Light microscopy (LM) was made with a Nikon microscope equipped with an automatic photographic system. Samples for these studies were mounted in Hoyer's medium. The SEM micrographs have been made with a Zeiss DSM-950 microscope. Spores samples were rehydrated with concentrated ammonium hydroxyde (28-30%) for 30 min, then dehydrated in aqueous ethanol (70%) for 1-1.5 hrs., afterwards immersed in pure acetone for at least 2 hours. Finally, the spores were fixed in formaldehyde dimetila-cetal followed by critical point drying and sputter-coating in gold-palladium.

The material of *Didymium laxifila* and *D. rubeopus*, is preserved in the herbarium of the Universidad de Alcalá (AH). The lectotype of *D. laxifilum* is in K.

## TAXONOMIC TREATMENT

*Didymium laxifilum* G. Lister & Ross in G. Lister, *Essex Naturalist* 27: 164. 1945. Figs. 1-23.

= *Didymium aurantipes* Brooks & Kowalski, *Mycologia* 58: 169-170.

**Collections examined.** England: Loughton (Epping Forest), on dead leaves, leg. G. Lister & H.J. Howard, 19.I.1944, n° 3501 (this collection is designated as the LECTO-TYPE and is deposited in K). Loughton, the Warren 16702. Spain: Badajoz, Azuaga, on leaves of *Quercus ilex*, leg. J.R. Garcia, 22.I.1992, AH 16429. Badajoz, Peralada del Zaucejo, on leaves of *Quercus suber*, leg. J.R. Garcia, 30.I.1994, AH 16725. Córdoba,

Fuenteovejuna, on leaves of *Quercus ilex*, leg. J.R. García, 15.I.1994, AH 14966. Málaga, road Cortes de la Frontera-Alcalá de los Gazules, on leaves of *Quercus suber*, leg. A. Ortega, M.T. Vizoso, E. Gallego, F. Esteve & C. Illana, 12.XII.1990, AH 13382, 13383 and 13385.

**Latin diagnosis.** *Peridiis sparsis vel subconfluentibus, profunde umbilicatis; stipitibus tenuibus, gilvis vel flavo-gilvis; columella hemispherica, floccis capillitii robustis, laxis, subsimplicibus vel in reticulo junctis; sporis fuscis, delicate verruculosis, 9-11 µm diam., area dehiscentiae pallida laeve.*

Sporocarps 0.5-1 mm diam., in small groups, subglobose, sometimes joined together, forming short plasmodiocarps, strongly umbilicate at the base, stipitate or sessile, whitish in colour. Hypothallus discoid, reddish. Stipe up to 0.5 mm tall, reddish, fibrous and without calcium carbonate crystals. Peridium simple, membranous, iridescent, with abundant deposits of white or yellowish calcareous crystals, irregularly dehiscing. columella white, hemispherical.

Capillitium consisting of thick filaments (5-8 µm diam.) which radiating from the columella, branching and anastomosing into a three-dimensional net, violaceous brown to dark brown, hyaline at the ends, with the surface smooth by SEM. Spores 10-13 µm diam., black in mass, very dark purple-brown under the microscope with a pale zone, spherical, verrucose. By SEM, the spores show an ornamentation formed of warts which are joined to form short crests completely covering the spore surface.

*Didymium rubeopus* var. *rubeopus* G. Moreno, Castillo & Illana, in Moreno, Castillo, Illana & Lizárraga, *Abstr. 2nd. Intern. Congr. Syst. Ecol. Myxomycetes*: 57. 1996. Figs. 24-33.

**Collections examined.** Spain: Córdoba, Fuenteovejuna, on leaves of *Quercus ilex*, leg. J.R. García, 11.XII.1993, AH 16444 and 16458 (holotype). Badajoz, Peralda del Zaucejo, on leaves of *Quercus suber*, leg. J.R. García, 13.XII.1993, AH 15221 and 18505.

**Latin diagnosis.** *Sporangia 0.4-1 mm diam., globulus, umbilicatus, albus vel pallide griseus; stipes parvus, usque ad 1 mm alt., rufus vel rufo-aurantiacus, crystalli absens. Peridium fuscus iridicentibus, crystalli calcari abundantibus exornatus. Columella alba, globosa. Capillitium fuscus vel obscurus, verus peridium hyalinus ad columella radiantibus, filiis tenuis, plus minusve parallelis, forse ramificatis, regularis, flexuosis, hic inde incrassatus, noduli reteque adsens. Sporis 9-11 µm. diam., globosis, atrovioleaceis, verrucosis. Plasmodium ignotus.*

Sporocarps 0.4-1 mm in diam., stipitate to sometimes sessile, scattered, globose or subglobose, white or light grey in colour, umbilicate. Short stipe, approximately of similar height as the sporotheca, reddish or reddish-orange, translucent, longitudinal wrinkles and without calcium carbonate crystals. Peridium simple, iridescent, covered with abundant whitish crystals, irregularly dehiscing. Hypothallus concolorous with the stipe, forming an extended base. Columella white, globose or hemispherical.

Capillitium formed by delicate, flexuous filaments (2-4 µm diam.) of equal width for their total length, more or less parallel, with some branching, which radiate from the columella, dark grey, hyaline towards the exterior, and with some globose swelling, without forming nodules or a well-defined net, with the surface rugose by SEM. Spores

9-11  $\mu\text{m}$  diam., black in mass, dark brown-violaceous under the microscope, globose, spiny. By SEM, the spore ornamentation is formed by 0.5  $\mu\text{m}$  tall pila, sometimes united, which homogeneously cover the whole surface. Plasmodium not observed.

***Didymium rubeopus* var. *albocapillitium* G. Moreno, Castillo, Illana & Lizárraga, var. nov. Figs. 34-40.**

**Collections examined.** Spain: Badajoz, Azuaga, on leaves of *Quercus ilex*, leg. J.R. García, 1.III.1994, AH 16736. Almería, Turrillas, on leaves of *Quercus ilex*, leg. V. González, A. Altés, C. Illana, 2.XII.1993, AH 16373, 16375, 16376, 16379 (holotype), 16383 and 16387. Almería, Turrillas, on leaves of *Quercus ilex*, leg. G. Moreno, A. Altés & C. Illana, 25.II.1994, AH 16649.

France: St. Martin de la Brasque, 12.XI.1994, herb. Meyer 15042 (duplo in AH 18391). Roquemaure-Aire autoroute, 22.IV.1996, herb. Meyer 16307 (duplo in AH 18392).

Mexico: Baja California, San Antonio de las Minas (near Ensenada), on leaves of *Quercus agrifolia*, leg. G. Moreno, 14.III.1990, AH 12634. Baja California, Rancho las Jacarandas (Cañón de las Ánimas), on leaves of *Sambucus mexicana*, leg. M. Lizárraga, G. Moreno & C. Illana, 7.II.1993, AH 15982, 15983, 21004 and 21006.

**Latin diagnosis.** *A Didymium rubeopus capillitio ex filis cylindraceis hyalinis vel albidis compositur differt.*

This variety differs from *Didymium rubeopus* var. *rubeopus* only by the filaments of the capillitium, which are from hyaline to whitish. The remaining macro- and micro-characters and the folicolous habitat are similar.

Currently, this new variety appears to be more abundant than *Didymium rubeopus*.

## DISCUSSION

Macroscopically, *Didymium rubeopus*, is similar to *D. laxifilum*, but the microscopical characters are distinct. *D. laxifilum* has a brown-violaceous to dark brown capillitium, hyaline at the ends, of thick and rigid filaments (5-8  $\mu\text{m}$  diam.), branched and anastomosed, forming a well defined three-dimensional net and the spore size are 10-13  $\mu\text{m}$  in diam. (not 9-11  $\mu\text{m}$  in diam. as described in latin diagnosis). On the contrary, *D. rubeopus* var. *rubeopus* has a brown to dark brown capillitium formed of more fine filaments (2-4  $\mu\text{m}$  diam.), more or less parallel, little branched, flexuous and with little globose expansion, without forming a characteristic net and spores 9-11  $\mu\text{m}$  in diam.

Under SEM, the capillitium of *D. laxifilum* has a smooth surface whereas that of *D. rubeopus* has a rugose surface. The spore ornamentation in *D. laxifilum* is formed by warts which may sometimes merge to form short crests, and totally cover the spore surface in a uniform fashion. In *Didymium rubeopus* the spore ornamentation is formed, according to the terminology of Rammeloo (1974), by 0.5  $\mu\text{m}$  tall pila, sometimes united, which are homogeneously distributed throughout the surface.

*Didymium rubeopus* var. *albocapillitium* differs from the var. *rubeopus* only by its hyaline to whitish capillitium. This variation in the colour of the capillitium has been found to be constant in the Spanish, French and Mexican material. The rest of the macro- and microscopical characters (sporocarp, colour of the stipe, morphology of the capillitium and spore ornamentation) are similar.

*Didymium ovoideum* Nann.-Bremek. also has sporocarps with a reddish stipe but its spores are smaller (6)7-8(9.5)  $\mu\text{m}$  diam (Nannenga-Bremekamp, 1991). A study of the spore ornamentation of this species was made by Gaither & Collins (1984).

*Didymium megalosporum* Berk. & Curt. is a species which has been interpreted in various ways, and which can be confused with the *D. rubeopus* but, after having studied and compared our collections with other exsiccates deposited in American and European herbaria, including the type, we reached the same conclusion as Ing, who also examined the type, deposited in Kew and declared "that it is undoubtedly the same as *D. eximium*" (Martin & Alexopoulos, 1969). *Didymium megalosporum* is a foliicolous species which is different from *D. rubeopus* by its flat columella, typically yellowish, with the straw-yellow stipe (Illana & al., 1997).

*Didymium laxifilum* is a species only known from France, England, Spain and the USA (Neubert & al., 1995). It has been collected in Spain on sclerophyllic mediterranean vegetation.

*Didymium rubeopus* and *D. rubeopus* var. *albocapillitium* are also two abundant foliicolous taxa on sclerophyllic plants, which may have been confused with the species previously mentioned.

**ACKNOWLEDGEMENTS** — This work has been possible through research project DGICYT PB 95-0129 and through a research project included in the "Programa de Cooperación con Iberoamérica, Ministerio de Educación y Ciencia, Subdirección General de Cooperación Internacional", Spain. Mr. M. Lizárraga wishes to express his gratitude to the "Consejo Nacional de Ciencia y Tecnología (CONACYT)" of Mexico for granting a fellowship to undertake a Ph.D. thesis on the Myxomycetes of Baja California.

We also thank Mrs. J.A. Pérez and A. Priego who belongs to the Electronic Microscopy Service of the University of Alcalá de Henares, for taking the photographs in the SEM. Mr. J.R. García for having sent the material from Badajoz and Córdoba and Mr. J. T. Palmer for checking the English text.

We also thank to Mr. J. Rejos curator of herbarium AH, and curator of herbarium K for sending the material of *Didymium laxifilum*.

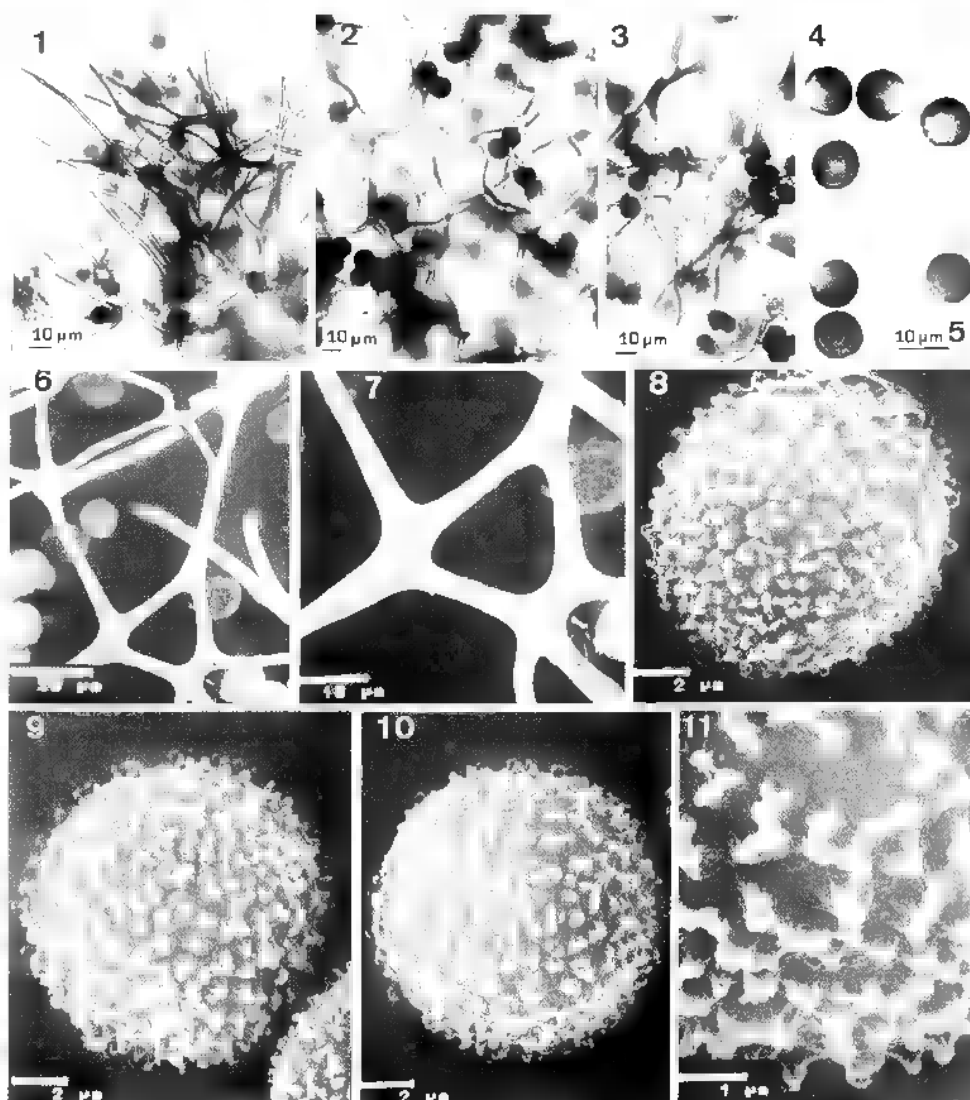
Thanks also to Mr. S. Hernández (Adenex, Extremadura) for his collaboration and his help.

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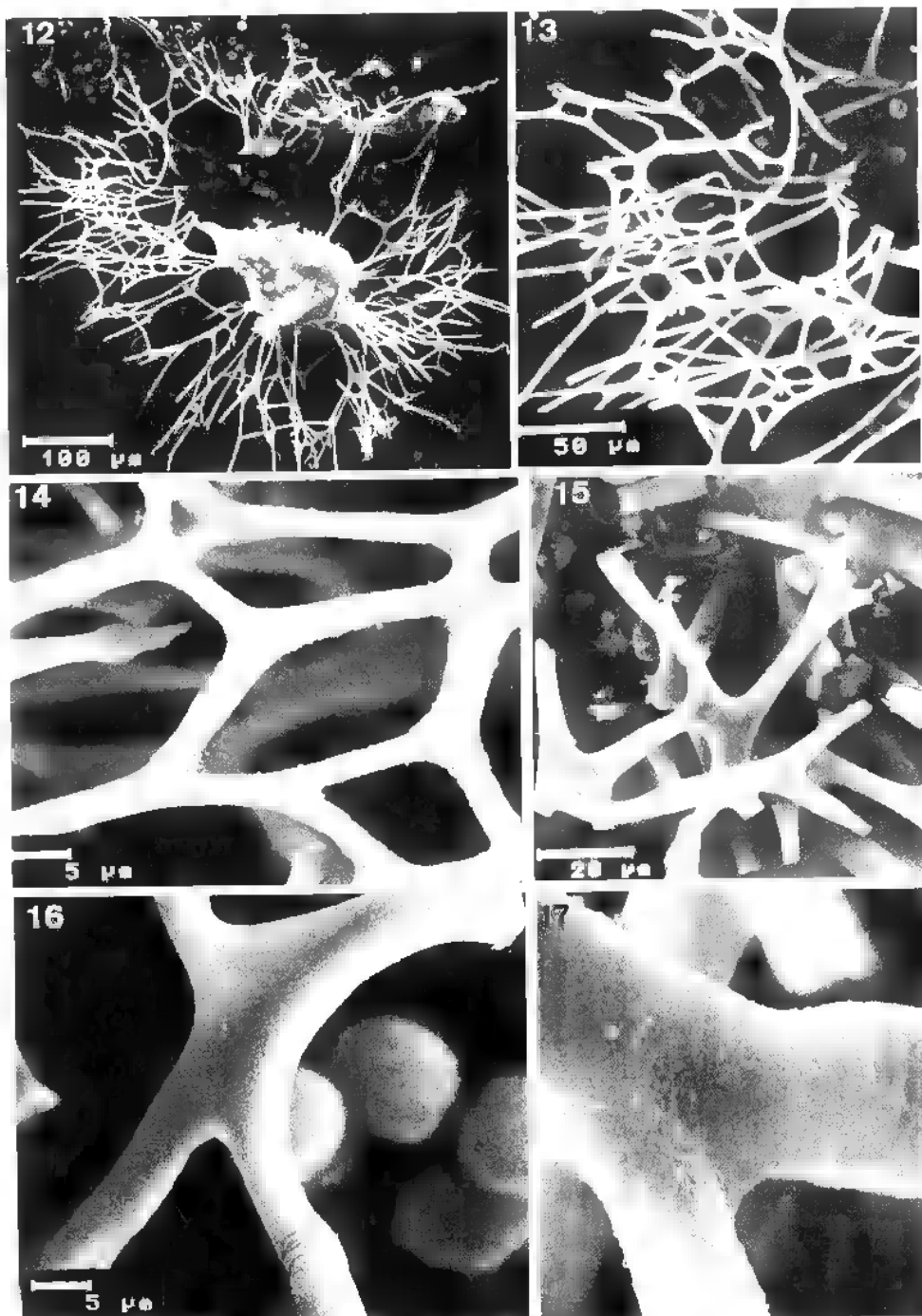
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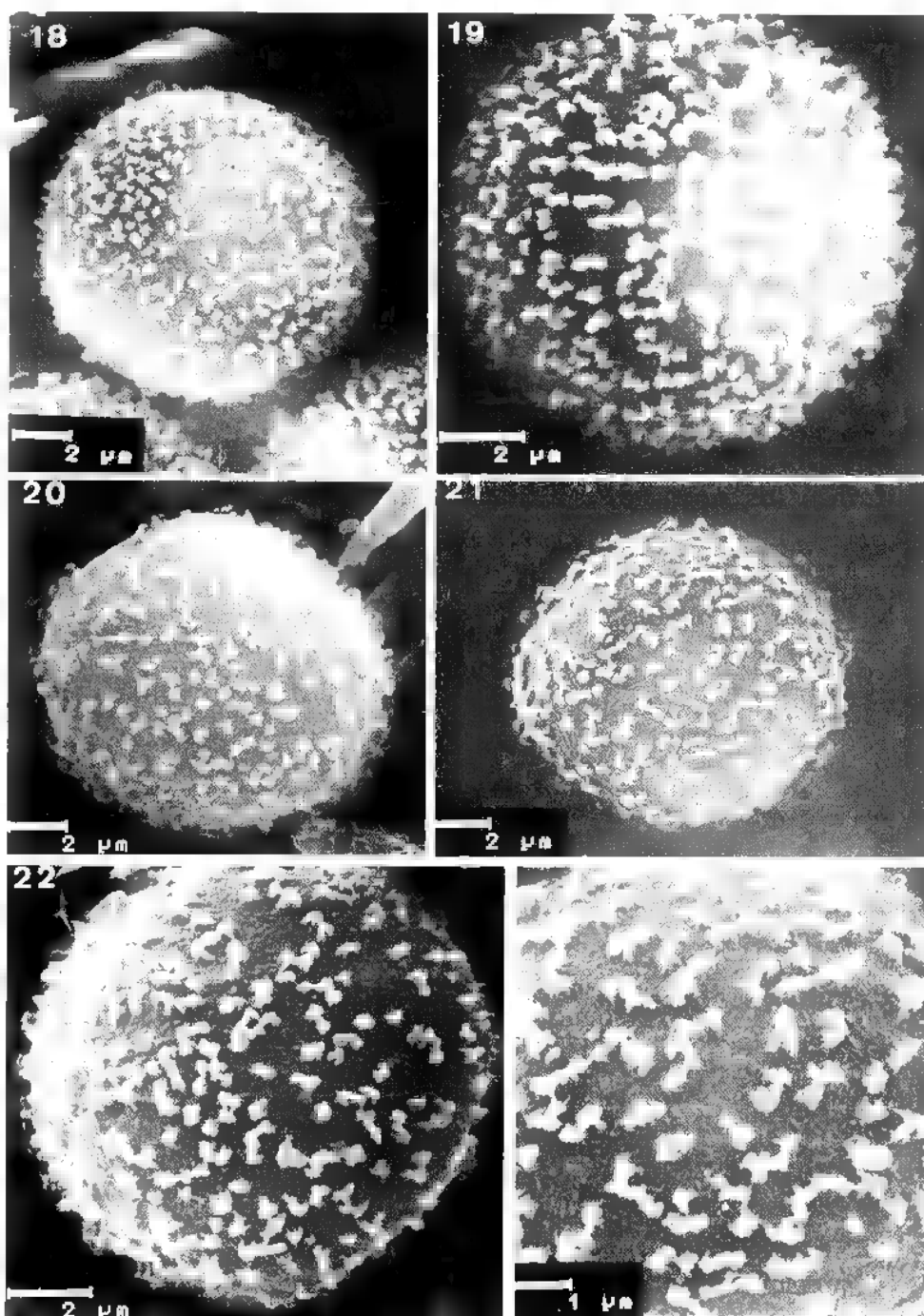




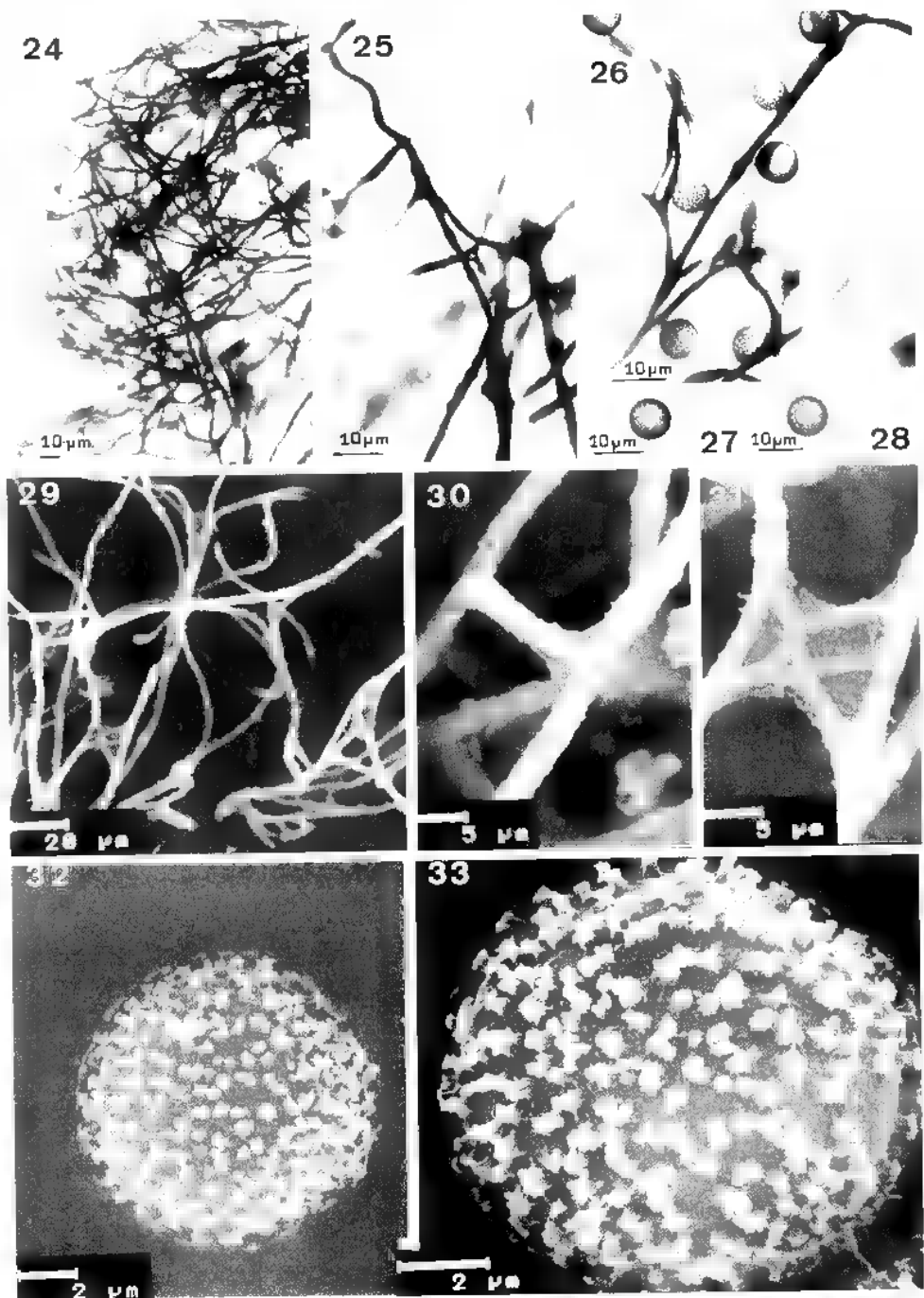
Figs. 1-11. — *Didymium laxifilum* (J. Ross 3501, lectotype). 1-3: detail of the capillitium (LM). 4-5: spores (LM). 6-7: capillitium (SEM). 8-10: spores (SEM). 11: detail of the spore ornamentation (SEM).



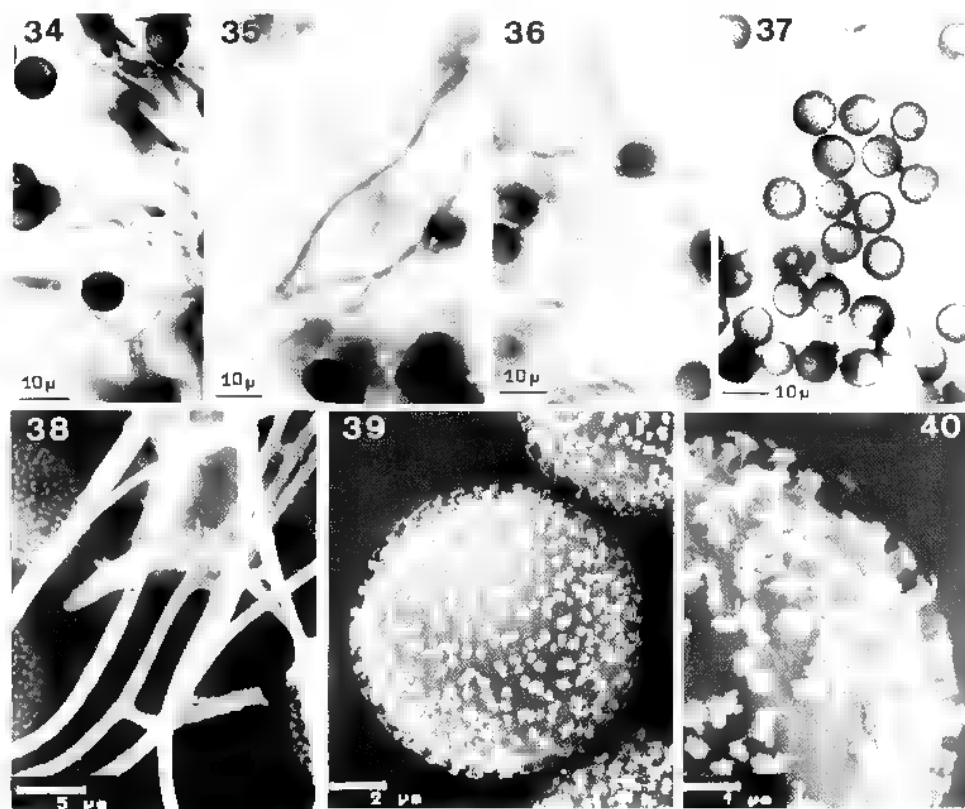
Figs. 12-17. - *Didymium laxifilum*. 12-13: detail del capillitium (J. Ross 3501, lectotype, SEM). 14-15: detail of the capillitium (AH 13383, SEM) . 16-17: detail of the capillitium (AH 16429, SEM).



Figs. 18-23 — *Didymium laxifilum*. 18-19: spores (Loughton, the Warren 16702, SEM). 20 - - 21: spores (AH 13383, SEM). 22-23: spore and detail of the spore ornamentation (AH 16429, SEM).



Figs. 24-33. — *Didymium rubeopus* var. *rubeopus* (AH 16458, type). 24-26: detail of the capillitium (LM). 27-28: spores (LM). 29-31: detail of the capillitium (SEM). 32-33: spores (SEM).



Figs. 34-40. — *Didymium rubeopus* var. *albocapillitium* (AH 16379, type). 34-36: detail of the capillitium (LM). 37: spores (LM). 38: capillitium (SEM). 39: spore (SEM). 40: detail of the spore ornamentation (SEM).



## A RARE *DIDYMIUM* FROM MEXICO (MYXOMYCETES)

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**ABSTRACT** — Three collections of a rare *Didymium* species were found on decaying desert vegetation (*Agave shawii* Engelm. and *Yucca* sp.) in Baja California, Mexico. A detailed description, including SEM-micrographs, is given for this new species. *Didymium mexicanum* is distinguished by its characteristic spore ornamentation.

**KEY WORDS:** Baja California, Mexico, *Didymium mexicanum*, Myxomycetes, scanning electron microscopy, taxonomy.

**RÉSUMÉ** — Trois récoltes d'une espèce rare de *Dydium* ont été réalisées sur débris végétaux (*Agave shawii* Engelm. and *Yucca* sp.) dans le désert de Baja California (Mexique). Cette nouvelle espèce, *Dydium mexicanum*, est décrite, après observation au microscope électronique à balayage. Elle se caractérise notamment par l'ornementation des spores.

**MOTS-CLEFS** — Baja California, Mexique, *Dydium mexicanum*, Myxomycètes, microscopie électronique à balayage, taxonomie.

Only sixteen species of Myxomycetes have been recorded from Baja California Peninsula (Ogata *et al.*, 1994; Lizarraga *et al.*, 1997a; Moreno *et al.*, 1997; Lizarraga *et al.*, 1998). Our forays in this area have recorded a rich myxobiota on the vascular flora.

The first photographs are presented here for *Didymium mexicanum*, a new species that was published in the abstract volume of the Second International Congress on the Systematics and Ecology of Myxomycetes celebrated in Madrid in April of 1996 (Lizarraga *et al.*, 1996). This species was collected three times in different localities on decaying desert vegetation.

Baja California represents mediterranean and desertic areas of interest for biodiversity in Myxomycetes. These study areas are compared to other similar areas in the Iberian Peninsula. We have observed that species described in California, have appeared in Europe and this is the case for *Didymium clavodecus* Whitney, (Lizarraga *et al.*, 1997b). *Didymium subreticulosporum* Oltra *et al.*, initially was described in Europe and later found abundantly in Baja California (Lizarraga *et al.*, 1998).

## DESCRIPTION

*Didymium mexicanum* G. Moreno, Lizárraga & Illana, in Lizárraga, G. Moreno, Illana & Castillo, *Abstr. 2nd. Intern. Congr. Syst. Ecol. Myxomycetes*: 56. 1996. (Figs. 1-13)

*Material studied. Didymium mexicanum.* MEXICO: Baja California. Cataviña-Bahía de los Angeles highway (near Cataviña), on decayed stalk of *Agave schawii*, 14-II-1993, G. Moreno, M. Lizárraga and C. Illana (Holotype AH 18481, Isotype in herbario Nannenga-Bremekamp n° 17.311). Road to Valle Las Palmas, Rancho Los Alisos, Tijuana, on decayed stalk of *Yucca sp.*, 13-XI-1994, M. Lizárraga & E.J. Torres (AH 17100). Road San Vicente-Erendira, cerro Solo, on decayed stalk of *Agave schawii*, 15-II-1996, M. Lizárraga (AH 19976).

*Material studied of other species. Didymium clavodecus.* MEXICO: Baja California. Tecate-Mexicali highway (Cañada Verde), on leaves of *Quercus agrifolia* Nec., 6-II-1993, M. Lizárraga, G. Moreno and C. Illana, AH 15927.

*Didymium dubium.* SPAIN: Guadalajara, on stem of *Cortaderia argentea*, 24-VI-1992, A. Castillo, AH 14884.

*Etymology.* In reference to its discovery on desert vegetation in Mexico.

Sporangia and plasmodiocarps scattered or in small groups; sporangia 0.2-1.5 mm diam., subglobose pulvinate or discoid, sessile or rarely on short stalks; plasmodiocarps discoid, pulvinate or elongate-depressed, 1 × 3-20 mm diam., lightly grooved above; stalks if present, very short, stout, calcareous, white; hypothallus scanty, pale violet; peridium single, membranous, iridescent, sprinkled with prismatic and stellate calcareous crystals, smaller than the spores; dehiscence irregular; columella none; capillitium abundant, threads delicate and free, up to 1 µm wide, sparingly branched, with very few cross bars, ends forked, pale brown, with some dark rounded or funnel-shaped swellings up to 3 µm diam.; spores (13-)14-16(-18) µm in diam., dark purple brown in mass, purple brown by transmitted light, polygonal in optical section, with strong ridges, bearing warts united laterally in a reticulum; the spore wall ornamentation as seen by SEM shows vertical processes that interconnect, without a free space underneath; plasmodium unknown.

The holotype has been deposited in the Herbarium of the Departamento de Biología Vegetal (Botánica), Universidad de Alcalá de Henares, Spain (AH). The isotype remains in the private collection of Nannenga Bremekamp in BR.

The fructifications of *Didymium mexicanum* resemble other members of the genus that have sessile sporangia and plasmodiocarps with stellate calcareous crystals sprinkled on the peridium. This species cannot be confused with any of the previously described species because of its spore morphology.

*Didymium mexicanum* is perhaps most closely related to *Didymium clavodecus* Whitney and *D. dubium* Rostaf., due to similarly shaped sporangia with scattered crystals. The spore morphology of *D. clavodecus* is represented by capitate warts (1-1.5 µm in length), occasionally fusing into short ridges (Fig. 15) (Whitney, 1979). The fructifications of *D. dubium* are similar to those of *D. mexicanum*, but the capillitium of the former is more elastic and the spores lack bands or ridges, and the ornamentation is characterized by fine warts and small delicate ridges which sometimes form a broken reticulum (Fig. 14) (Nannenga-Bremekamp, 1991).

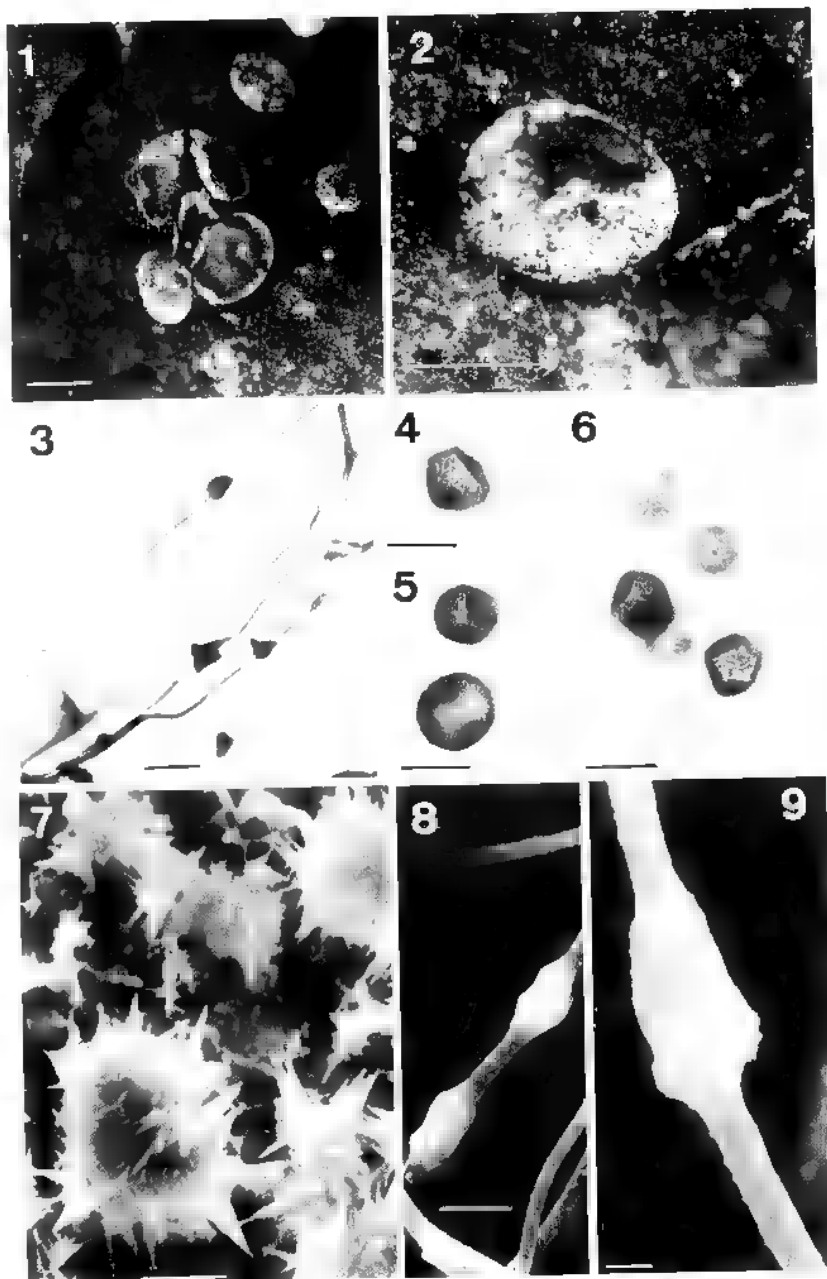


## ACKNOWLEDGMENTS

This study was made possible through a research project included in the "Programa de Cooperación con Iberoamérica, Ministerio de Educación y Ciencia, Subdirección General de Cooperación Internacional", Spain. M. Lizárraga wishes to express his gratitude to the "Consejo Nacional de Ciencia y Tecnología (CONACYT)" of México for granting a fellowship to undertake a Ph.D. thesis on the Myxomycetes of Baja California and Mr. E.J. Torres for his help in the field work. We wish to express our gratitude to Mrs. Nannenga-Bremekamp and Dr. H.W. Keller for his revision and scientific comments. We also thank Mr. J.A. Pérez for his invaluable help with the SEM. This research has been partially supported by the Research Project DGICYT PB 95-0129. This paper was presented at the Second International Congress on the Systematics and Ecology of Myxomycetes, Madrid (ICSEM2).

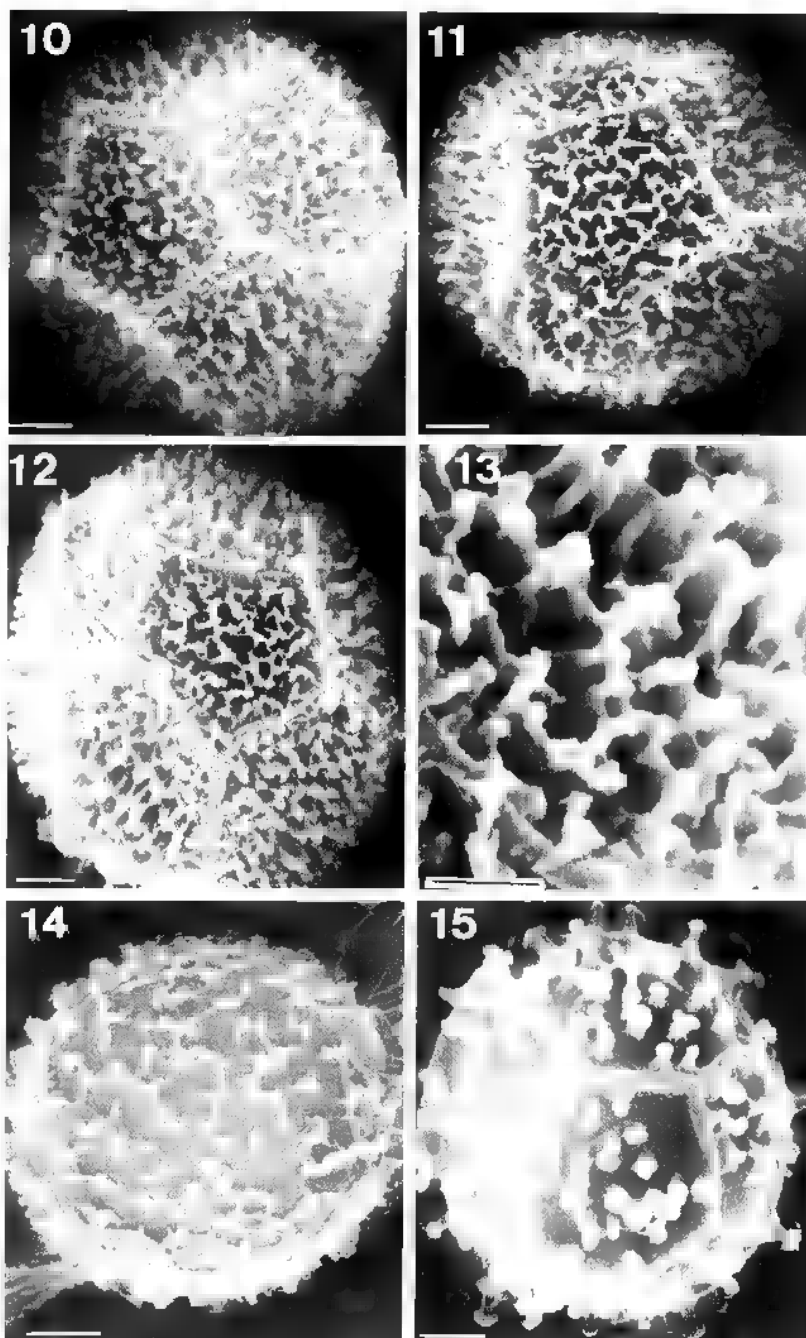
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Figs. 1-9. — *Didymium mexicanum*, AH 18481, holotype. Fig. 1. Habit, Fig. 2. Sessile sporangia with calcareous crystals scattered on the peridium. Fig. 3. Photomicrograph of capillitial threads with pigmented swellings. Figs. 4-6. Optical section of angular spores. Fig. 7. SEM of stellate calcareous crystals of the peridium. Figs. 8-9. SEM of capillitial threads with swellings. Scale bars: Figs. 1-2 = 1 mm, Figs. 3-6 = 10  $\mu$ m, Figs. 7-8 = 5  $\mu$ m, Fig. 9 = 1  $\mu$ m.

Figs. 1-9.— *Didymium mexicanum*, AH 18481, holotype. Fig. 1. Aspect général, Fig. 2. Sporange sessile avec cristaux calcaires recouvrant le peridium. Fig. 3. Filaments du capillitium à épaississements pigmentés. Figs. 4-6. Spores anguleuses. Fig. 7. Cristaux calcaires étoilés du peridium (MEB). Figs. 8-9. Épaississements des filaments du capillitium (MEB). Echelle: FIGS. 1-2 = 1 mm, Figs. 3-6 = 10  $\mu$ m, Figs. 7-8 = 5  $\mu$ m, Fig. 9 = 1  $\mu$ m.



Figs. 10-13.— *Didymium mexicanum*, AH 18481, holotype. Figs. 10-12. SEM of spores. Fig. 13. SEM of spore surface ornamentation. FIG. 14. *Didymium dubium*, AH 14884. SEM of spore ornamentation. Fig. 15. *Didymium clavodecus*, AH 15927. SEM of spore ornamentation. Scale bars: Figs. 10-12 = 2  $\mu$ m, FIG. 13 = 1  $\mu$ m, Figs. 14-15 = 2  $\mu$ m.

Figs. 10-13. — *Didymium mexicanum*, AH 18481, holotype. Figs. 10-12. Spores (MEB). Fig. 13. Ornamentation sporale (MEB). FIG. 14. *Didymium dubium*, AH 14884. Ornamentation sporale (MEB). FIG. 15. *Didymium clavodecus*, AH 15927. Ornamentation sporale (MEB). Echelle: Figs. 10-12 = 2  $\mu$ m, FIG. 13 = 1  $\mu$ m, Figs. 14-15 = 2  $\mu$ m.



## **OBSERVACIONES ECOLÓGICAS Y BIOGEOGRÁFICAS SOBRE LOS HONGOS DEL JARDÍN BOTÁNICO Y DEL PARQUE ECOLÓGICO DE XALAPA, VERACRUZ, MÉXICO**

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**RESUMEN** — Se analiza el hábitat, abundancia, fenología y afinidades biogeográficas de 205 especies de hongos, principalmente macromicetos (4 Deuteromycota, 29 Ascomycotina y 172 Basidiomycotina) que crecen en el Jardín Botánico y en el Parque Ecológico del Instituto de Ecología de Xalapa, Veracruz. La vegetación de dicha zona se adscribe al bosque mesófilo de montaña, con diferentes grados de disturbio.

**ABSTRACT** — The habitat, abundance, phenology and biogeographical affinities of 205 species of fungi, mainly macromycetes (4 Deuteromycota, 29 Ascomycotina and 172 Basidiomycotina) from the Botanical Garden and the Ecological Park of the Ecology Institute of Xalapa, Veracruz, are discussed. The vegetation of the area is a mesophytic forest type, with different degrees of disturbance.

**KEY WORDS** — Fungi, Ecology and Biogeography, Botanical Garden, Xalapa, Mexico.

**RÉSUMÉ** — L'habitat, l'abondance, la phénologie et les affinités biogéographiques de 205 espèces de champignons, principalement des macromycètes (4 Deuteromycota, 29 Ascomycotina et 172 Basidiomycotina) du Jardin Botanique et du Parc Écologique de l'Institut d'Ecologie de Xalapa, Veracruz sont discutés. La végétation de la région est du type mesophyte à subtropical humide, avec différents degrés de perturbation.

**MOTS CLÉS** — Champignons, écologie, biogéographie, Jardin Botanique, Xalapa, Mexique

## **INTRODUCCIÓN**

Son muy pocos los estudios micológicos realizados en los Jardines Botánicos o Parques Nacionales de México y escasos también los confinados al bosque mesófilo de montaña. Los trabajos de Galindo-Flores (1992) sobre los hongos del Jardín Botánico

Tizatlán en Tlaxcala; Cifuentes *et al.* (1990, 1993) sobre los hongos de Los Azufres en Michoacán y del Parque Ecológico de Omiltemí en Guerrero; Rodríguez-Scherzer & Guzmán-Dávalos (1984) sobre los hongos de las Reservas de la Biósfera de la Michilía y Mapimi en Durango y el de Heredia (1989) sobre los hongos de la Reserva de la Biósfera el Cielo en Tamaulipas, son algunas contribuciones afines al tema del presente trabajo. Por otra parte, referente al bosque mesófilo de montaña de México (también conocido como bosque subtropical), Chacón & Medel (1993) analizaron los hongos registrados de dicho bosque en el país y consideraron 594 especies en 103 trabajos y de éstas, 256 se adscriben al Estado de Veracruz.

En relación con los hongos del bosque mesófilo de montaña del Jardín Botánico y del Parque Ecológico del Instituto de Ecología y de los alrededores de Xalapa, no existe ningún estudio específico que los aborde, de no ser un estudio fenológico sobre diez especies que realizaron los autores recientemente (Chacón & Guzmán, 1995) y de dos nuevos registros del área (Chacón, 1995). Sin embargo, en varias contribuciones sobre la micobiota de México se registran numerosas especies de los alrededores de Xalapa, como son las de Murrill (1908, 1910, 1912, 1915, 1916, 1917, 1918, 1919 y 1921); Guzmán (1983); Chacón & Guzmán (1983a, 1983b); Pérez-Silva *et al.* (1983a, 1983b); Guzmán & Guzmán-Dávalos (1984); Santillán & Valenzuela (1986); García *et al.* (1986); Guzmán *et al.* (1986, 1988, 1990, 1991, 1992); Bandala-Muñoz *et al.* (1987); Montoya *et al.* (1990); Montoya-Bello *et al.* (1987) Anell & Guzmán (1988), Medel & Chacón (1988); Medel *et al.* (1989); Villegas & Cifuentes (1988); San Martín & Rogers (1989); Singer *et al.* (1991) y Ryvardeen & Guzmán (1993), Chacón *et al.* (1995).

## ÁREA DE ESTUDIO

La zona considerada se localiza aproximadamente a 1 km al SO de la ciudad de Xalapa y está situada entre las dos carreteras a Coatepec, la antigua y la nueva; comprende cerca de 27 hás. (fig. 1). El terreno es escarpado, pero la altitud varía de entre 1250 a 1300 m y el clima, con base en la estación meteorológica de Xalapa (Soto, 1990), es templado húmedo con lluvias durante todo el año, de tipo cf(m)llw''b(i)g, con temperatura promedio anual de 18°C y precipitación pluvial total anual de 1490 mm. Las zonas boscosas del área cubren aproximadamente 15 hás. y se adscriben al bosque mesófilo de montaña, en donde los árboles de los géneros *Liquidambar*, *Quercus*, *Carpinus*, *Prunus* y *Platanus* son de los más representativos. Dicho bosque se encuentra en más del 70 % perturbado y grandes áreas son cafetales, jardines o zonas fuertemente alteradas.

## METODOLOGÍA

Se realizaron más de 150 exploraciones al área de estudio entre 1983 y 1993. Cerca de 1000 especímenes de hongos fueron recolectados, los cuales se hayan depositados en la Colección de Hongos del Herbario del Instituto de Ecología. Se estudiaron también aproximadamente 500 especímenes de la zona, depositados en dicha colección. Las identificaciones se basaron en observaciones al microscopio óptico a través de preparaciones montadas en KOH al 5%, azul de algodón en lactofenol o solución de Melzer, según el caso. Las observaciones sobre la ecología de las especies estudiadas, se apoyan en los trabajos de Kalamees (1980), Guzmán-Dávalos & Guzmán (1979) y Guzmán (1977), entre otros. De acuerdo a la función trófica que tienen las especies, se clasificaron en

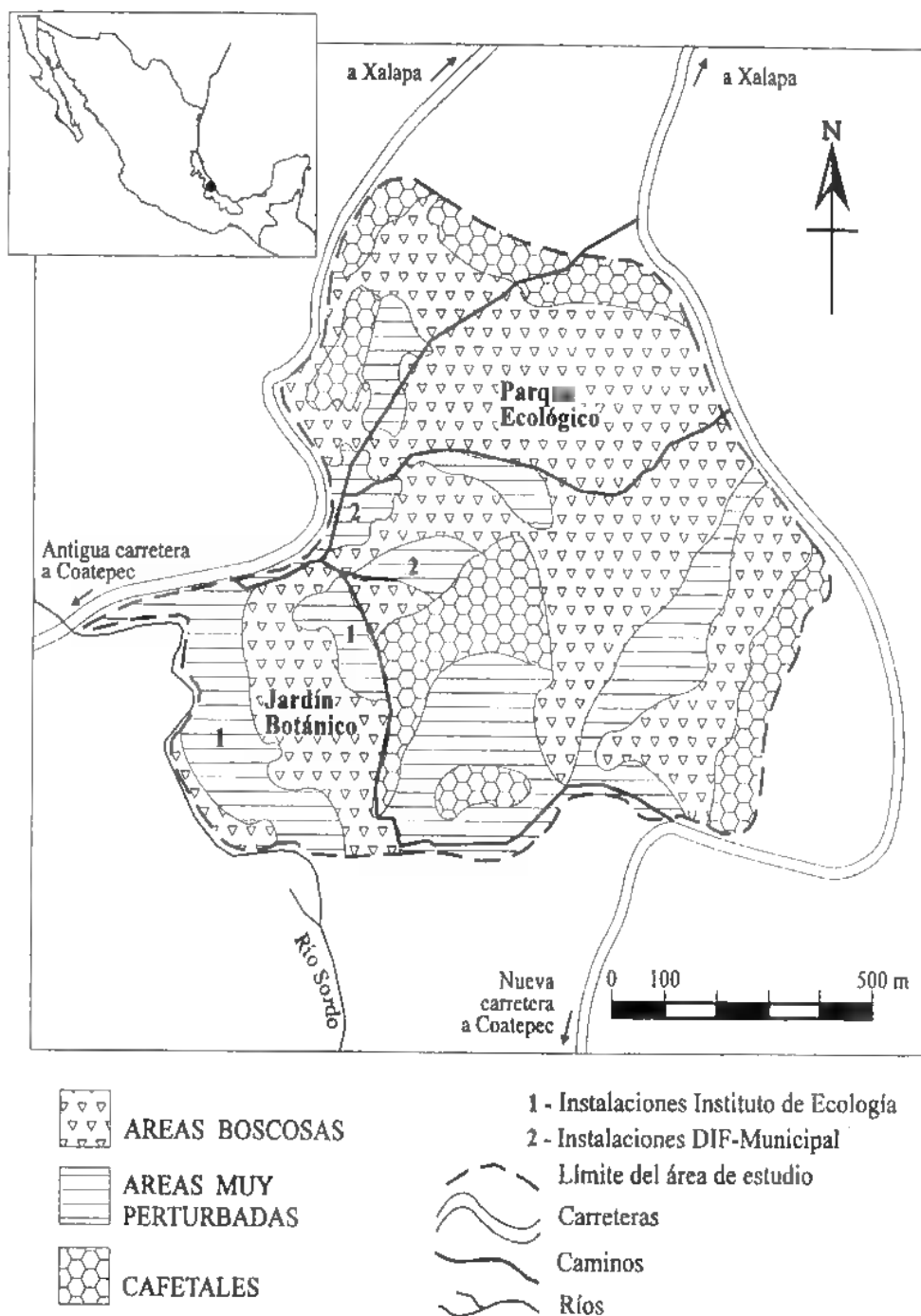


Fig. 1. Situación del área de estudio y distintos tipos de vegetación de la zona.

Fig. 1. Situation of the studied area and the different kinds of vegetation.

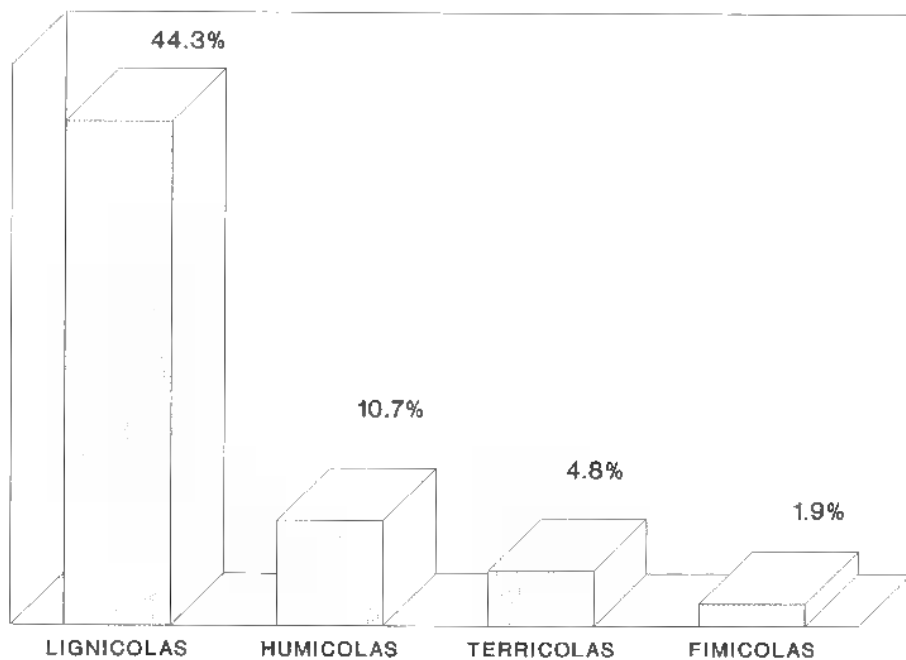
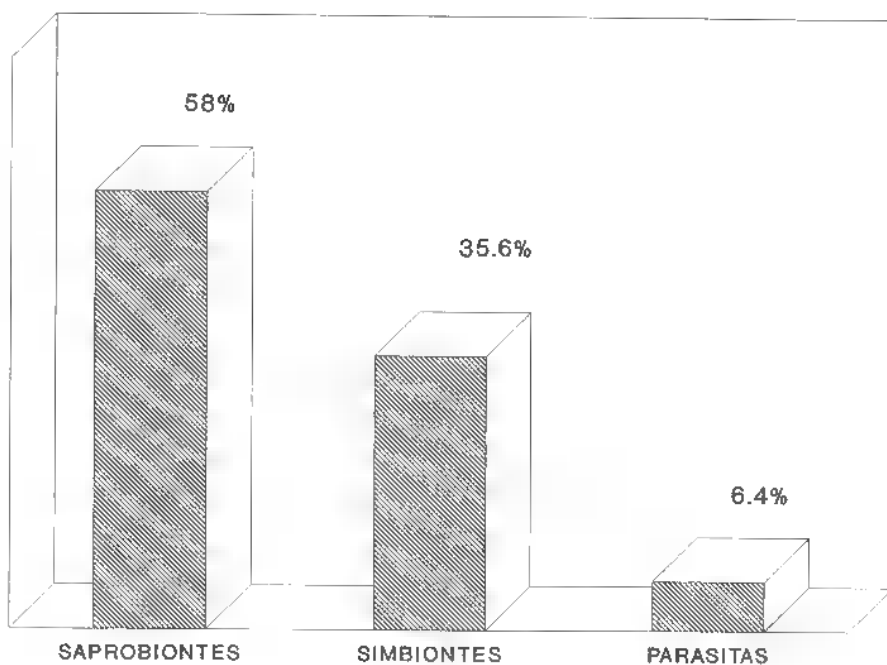
saprobiontes, simbioses (micorrízicas) y parásitas. Las saprobiontes se dividieron a su vez en húmicolas, terrícolas, lignícolas y fimícolas. La selección de los hongos micorrízicos se hizo de acuerdo con Trappe (1962). Las especies patógenas se agruparon en parásitas de plantas, de insectos y de otros hongos. La abundancia o escasez se basó en la cantidad de fructificaciones recolectadas por especie, a través de los últimos diez años de observaciones. Se consideraron escasas las especies que se recolectaron en 10 o menos ocasiones y abundantes las que presentaron más de 10 recolecciones. El estudio sobre la afinidad biogeográfica, se basó en las interpretaciones y observaciones de Guzmán (1973, 1977).

## RESULTADOS

Se identificaron 205 especies de hongos, de las cuales 4 son Deuteromycota, 29 Ascomycotina y 172 Basidiomycotina. De ellas, 20 son nuevos registros para el Estado de Veracruz y 6 no se conocían para el bosque mesófilo de montaña del país, como se indica en la tabla 1. Entre las especies más representativas por la abundancia de sus fructificaciones, están *Cordyceps entomorrhiza* con 57 recolecciones, *Amanita virosa* con 49, *Armillaria tabescens* con 43, *Tylophylus subcellulosus* con 42, *Russula virescens* con 39, *Amanita gemmata* var. *gemmata* con 36, *Tylophylus balloui* con 36, *Lactarius indigo* con 35, *Veligaster nitidum* con 32, *Oudemansiella canarii* con 31 y *Auricularia fuscosuccinea*, *A. cornea* y *Schizophyllum commune* con alrededor de 30. Especies escasas, con menos de 10 recolecciones son: *Chlorociboria aeruginascens*, *Coltricia perennis*, *Cordyceps militaris*, *Conocybe lactea*, *Datronia mollis*, *Ganoderma curtisii*, *Helvella macropus*, *Hydnopolyporus fimbriatus* y *Laetiporus sulphureus*, entre otras (véase tabla 1).

De acuerdo con la función trófica que tienen los hongos en el bosque, los saprobiontes son los más abundantes con 119 especies (58% del total); le siguen en importancia los simbioses (micorrízicos) con 73 (35.6%) y los parásitos con 13 (6.4%), como se puede observar en la figura 2. Referente a los hongos saprobiontes, 91 son las especies lignícolas, 22 las húmicolas, 10 las terrícolas y 4 las fimícolas, lo que equivalió al 44.3, 10.7, 4.8 y 1.9%, respectivamente (fig. 3). Cabe señalar que algunas especies presentan más de un tipo de hábitat, como son los casos de *Coprinus atramentarius*, *Hypholoma subviride*, *H. aurantiaca*, *Coprinus disseminatus* y las tres especies de *Armillaria* indicadas en la tabla 1, que pueden ser terrícolas o lignícolas, terrícolas o húmicolas, o saprobiontes y parásitas, respectivamente. Entre los hongos lignícolas, las familias *Polyporaceae* con 31 especies y *Tricholomataceae* con 19, fueron las más representativas. De los poliporáceos sobresalen por su abundancia *Coltricia cinnamomea*, *Trametes versicolor*, *Gloeophyllum striatum*, *Polyporus arcularius*, *P. tricholoma*, *Rigidoporus ulmarius* y *Trametes villosa* y entre los *Tricholomataceae*, *Schizophyllum commune*, *Pleurotus djamor* var. *djamor* y *Oudemansiella canarii* fueron los más comunes. Llamó la atención que las especies húmicolas son poco comunes en el área, como son *Aseroe rubra*, *Calostoma cinnabarina*, *Clathrus columnatus*, *Gaeastrum saccatum*, *Lepiota atrodisca*, *L. cristata*, *Leucoagaricus rubrotinctus*, *Mycena chlorinosma*, *M. pura* y *Octospora leucoloma*, no así *Coprinus disseminatus* que es muy abundante al inicio de la temporada de lluvias. Las especies fimícolas fueron solamente *Psilocybe cubensis*, *P. coprophila*, *Podosordaria leporina* y *Cyathus stercoreus*, lo que indica la poca influencia ganadera en el área y la baja población de mamíferos silvestres. Especies nitrófilas o subfimícolas son *Conocybe lactea*, *Stropharia coronilla*, *Coprinus atramentarius* y *Panaeolus subbalteatus*, las cuales son comunes en los suelos abonados de los prados. Otras especies comunes en los pastos de los jardines, son las dos de *Vascellum* de la tabla 1.





Figs. 2 y 3. Porcentaje de las especies estudiadas en cuanto a su ecología, Fig. 2 (arriba): de acuerdo a la función ecológica. Fig. 3 (abajo): especies saprobiontes en relación con el sustrato.

Figs. 2 and 3. Percentage of the species studied in relation to their ecology, Fig. 2 (above): According to ecological function. Fig. 3 (below): Saprobiont species in relation to the substratum.

Hongos ectomicorrízicos típicos del bosque mesófilo de montaña y asociados con *Quercus* son: *Amanita hemibapha*, *A. virosa*, *Tylopilus balloui*, *T. subcellulosus*, *Russula mephitica*, *R. virescens*, *Lactarius indigo* y *Veligaster nitidum*. Especies micorrízicas características del *Pinetum* del jardín, formado por especies introducidas, de pinos, son: *Cantharellus cibarius*, *Lactarius deliciosus*, *Russula brevipes*, *R. nigricans*, *Scleroderma areolatum*, *Suillus americanus*, *S. brevipes*, *S. truncatus* y *Xerocomus chrysenteron*, entre otras. Los hongos patógenos parásitos en hongos son *Sepedonium ampullosporum* y *S. chrysospermum* sobre fructificaciones de *Amanita*, *Lactarius*, *Russula* y diversas especies de Boletáceos. Hongos parásitos de insectos son *Paecilomyces fumosoroseus*, *Cordyceps entomorrhiza* y *C. militaris*. Por otra parte, *Armillaria mellea*, *A. polymyces*, *A. tabescens* e *Hydnopolyporus fimbriatus* son parásitos de raíces de diversos árboles, de las cuales *A. polymyces* y *A. tabescens* resultaron ser las más comunes, tanto en árboles silvestres como en introducidos, entre éstos últimos en *Eucalyptus*, *Coffea*, *Psidium* y varias especies de *Citrus*.

Referente a la fenología de las especies, todos los hongos del área crecen preferentemente en los meses más húmedos del año, que son los de julio a septiembre, como ocurre con la mayoría de los hongos en el país (Guzmán 1977). Sin embargo, se observó que hay especies que se desarrollan durante casi todo el año, como son las de *Auricularia*, *Pleurotus djamor* var. *djamor*, *Panaeolus subbalteatus*, *Conocybe lactea*, *Coprinus disseminatus*, *Leucocoprinus flos-sulfuris*, *Armillaria polymyces*, *A. tabescens* y *Veligaster nitidum*. Otras especies como *Russula virescens* y *Amanita virosa* inician su fructificación en los meses de abril y mayo. *Oudemansiella canarii* y *Cordyceps entomorrhiza* se consideran especies tardías por desarrollarse hasta los meses de octubre a noviembre. Chacón & Guzmán (1995) estudiaron la fenología de 10 especies comunes en el área, tales como *Oudemansiella canarii*, *Veligaster nitidum* (como *Scleroderma tenerum*), *Lactarius indigo*, *Tylopilus balloui*, *T. subcellulosus*, *Amanita gemmata* var. *gemma*, *A. virosa*, *Russula virescens*, *Armillaria tabescens* y *Cordyceps entomorrhiza*, anotando que todas crecen entre junio a octubre, excepto *T. balloui* que no se encontró en agosto; algunas especies extienden su desarrollo hasta noviembre o diciembre y otras inician su fructificación en abril o mayo, pero *Veligaster* y *Armillaria* crecen casi todo el año. En general en el mes de agosto disminuyen las fructificaciones en todas las especies, debido a escasez de las lluvias y a un ligero aumento de la temperatura, como ha sido observado por Guzmán (1983); Guzmán *et al.* (1988) en otros hongos en el país y por Chacón & Guzmán (1995) en los hongos del área.

En relación con las afinidades biogeográficas de los hongos estudiados, se observó que solo una especie, *Pleurotus smithii*, que se encontró parasitando *Psidium guajava* L., "guayabo", es aparentemente de afinidad austral (Guzmán *et al.*, 1991); 76 (37%) tienen afinidad boreal, 49 (23.9%) tropical, 63 (30.7%) son comunes en el bosque mesófilo de montaña y 16 (7.8%) presentan amplia distribución, como se puede ver en la figura 4. Entre estas últimas están *Cordyceps militaris*, *Dacryopinax elegans*, *Stereum fasciatum*, *Ganoderma curtisii*, *G. lucidum*, *Xeromphalina tenuipes*, *Panaeolus subbalteatus*, *Psilocybe coprophila*, *Geastrum saccatum*, *Cyathus olla* y *C. stercoreus*. Interesante es observar que la mayoría de los hongos lignícolas del área de estudio, tienen afinidad tropical como son las especies de *Auricularia*, *Trametes villosa*, *Pycnoporus sanguineus*, *Hexagonia hydnoidea*, *Coriopsis polyzona*, *Lentinus crinitus*, *Oudemansiella canarii* y *Schizophyllum commune*, entre otros, lo que demuestra la influencia tropical en el bosque mesófilo de montaña. En contraste con ello, está la presencia de *Chlorociboria aeruginascens* que es típica de los bosques de coníferas del país (Guzmán 1977; Valenzuela 1990). Es importante aclarar, que en el computo de las especies con afinidad boreal, se tomaron

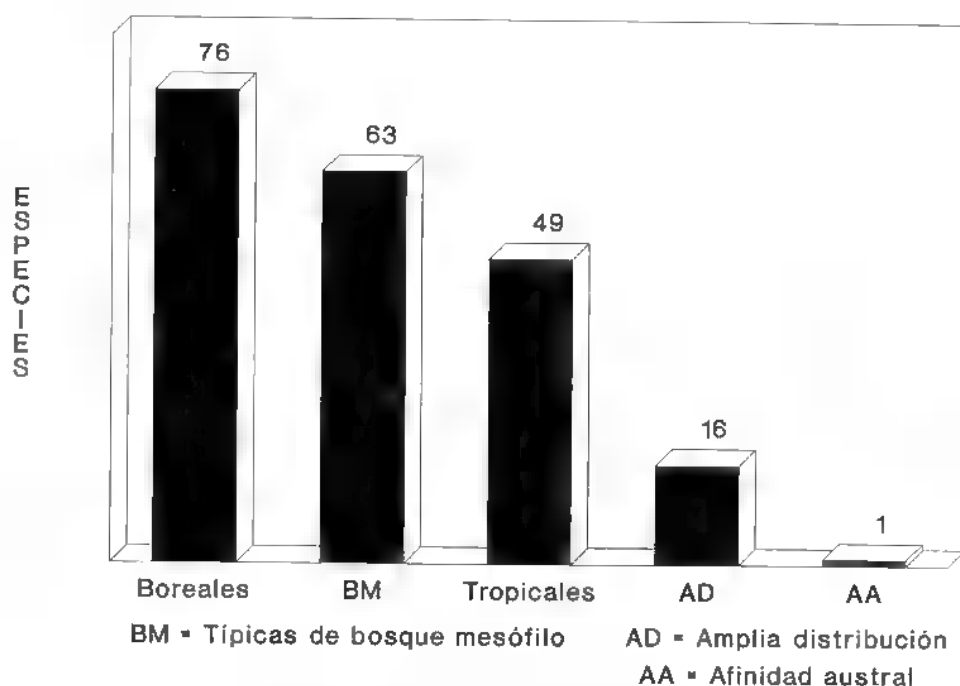


Fig. 4. Afinidad biogeográfica de los hongos estudiados (número de especies).

Fig. 4. Biogeographical affinity of the fungi studied (species number).

aquéllas introducidas en el *Pinetum* del Jardín Botánico o bajo pinos dispersos en otras áreas del Parque Ecológico; dichas especies son *Gloeophyllum saepiarum*, *Cantharellus cibarius*, *Neolentinus lepideus*, *Xerocomus chrysenteron*, *Lactarius deliciosus*, *L. vellereus*, *Russula brevipes*, *R. nigricans*, *Lycoperdon perlatum*, *Pisolithus arrhizus*, *Scleroderma areolatum* y las 3 especies de *Suillus* citadas en la tabla 1. En el género *Hypholoma*, es interesante observar que en el bosque mesófilo de montaña las especies más abundantes son *H. subviride* y *H. aurantiacum*, mientras que en el *Pinetum* predomina *H. fasciculare*.

### CONCLUSIONES Y DISCUSIÓN

El área de estudio tiene una rica micobiota, por ahora representada por 205 especies, de las cuales únicamente 63 son típicas del bosque mesófilo de montaña. La situación geográfica del área (latitudinal y altitudinal) y su clima templado húmedo, como en otras zonas del bosque mesófilo de montaña en el país, favorece el desarrollo simultáneo de especies con distribución boreal y tropical (Chacón & Medel, 1993) y de ahí el término de bosque subtropical aplicado a dicha formación (Guzmán, 1977). El 37% de los hongos con afinidad boreal, incluyendo los introducidos en las plantaciones de pinos, resulta comparable con los datos obtenidos por Díaz-Barriga *et al.* (1988) para el bosque

mesófilo de montaña de Michoacán, más no así para el de Tamaulipas en donde la presencia de especies con afinidad tropical es mayor según las observaciones de Heredia (1989, 1994). La abundancia de hongos saprobios en el área, con más del 50%, demuestra la riqueza de materia orgánica y la importancia de dichos organismos en la estabilidad del ecosistema. Es interesante observar que especies frecuentes en zonas de alto disturbio y observadas en la región de Xalapa por uno de los autores (Guzmán) y por Guzmán & Guzmán-Dávalos (1984) como son *Tricholoma pachymeres* (Berk. & Br.) Sacc., *Bolbitius vitellinus* (Pers.: Fr.) Fr., *Panaeolus antillarum* (Fr.) Dennis, *P. foeniseccii* (Pers.: Fr.) Kühn., *Psilocybe caerulescens* Murrill, y *Coprinus comatus* (Müller: Fr.) Gray, no fueron encontradas en el área de estudio, lo que pone de manifiesto la irregularidad en la fructificación de los hongos, la cual está supeditada a varios factores y sigue determinados periodos no estudiados todavía (Guzmán, 1994).

**AGRADECIMIENTOS** — Los autores reconocen al CONACyT (parte de los Proyectos P220CCOR-892160 y 1810-N9211) por el apoyo otorgado a la presente investigación. A la M. en C. Rosario Medel del Instituto de Ecología, se le agradecen sus comentarios y sugerencias. El técnico Fidel Tapia, también del Instituto de Ecología, colaboró significativamente en el inventario del material herborizado y en algunas observaciones al microscopio. A la Dra. Isabel Baroa se le agradece por la escritura del resumen en Francés. Ma. Eugenia Ramírez y Juan Lara ambos del Instituto de Ecología se les agradece por el apoyo logístico brindado.

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Tabla 1. Hongos estudiados y datos sobre su abundancia, hábitat y distribución

<b>DEUTEROMYCOTA</b>		
<i>Paecilomyces fumosoroseus</i> (Wize) Brown & Smith		2, 11, 15
<i>Sepedonium ampullosporium</i> Damon		2, 10, 12
<i>S. chrysospermum</i> (Bull.) Link: Fr.		2, 10, 12
<i>Stilbella cinnabarina</i> (Mont.) Wollenweber		2, 5, 8, 13
<b>ASCOMYCOTINA</b>		
<b>CLAVICIPITALES</b>		
<i>Cordyceps entomorrhiza</i> (Dicks.: Fr.) Link		1, 11, 14
<i>C. militaris</i> (Ehrh.: Fr.) Link		2, 11, 15
<b>SPHAERIALES</b>		
<i>Daldinia concentrica</i> (Bolt.: Fr.) Ces. & De Not.		2, 5, 8, 13
<i>D. loculata</i> (Lév.) Sacc.		2, 5, 8, 13
<i>Penzigia conostoma</i> (Mont.) J.H. Mill.		2, 5, 8, 14
<i>P. enteroleuca</i> (Speg.) Sacc.		2, 5, 8, 14
<i>Phyllacia poculiformis</i> (Mont.) Mont.		2, 5, 8, 13
<i>Podosordaria leporina</i> (Ellis & Everh.) Dennis		2, 3, 8, 13
<i>Xylaria cubensis</i> (Mont.) Fr.		2, 5, 8, 13
<i>X. fockei</i> (Miq.) Cooke		2, 5, 8, 13
<i>X. hypoxylon</i> (L.: Fr.) Grev.		1, 5, 8, 13
<i>X. longipes</i> Nitschke		2, 5, 8, 14
<i>X. persicaria</i> (Schwein.: Fr.) Berk. & M.A. Curtis		2, 5, 8, 14
<i>X. polymorpha</i> (Pers.: Fr.) Grev.		1, 5, 8, 13
<b>HYPOCREALES</b>		
■ <i>Hypomyces luteovirens</i> (Fr.: Fr.) Tul.		2, 10, 12
<i>Nectria cinnabarina</i> (Tode: Fr.) Fr.		2, 5, 8, 13
<i>N. pseudotrichia</i> (Berk. & M.A. Curtis) Seeler		2, 5, 8, 13
<b>PEZIZALES</b>		
<i>Helvella macropus</i> var. <i>brevis</i> Peck		2, 6, 8, 14
<i>H. macropus</i> (Pers.: Fr.) P. Karst. var. <i>macropus</i>		2, 6, 8, 12
<i>H. pezizoides</i> Afz.: Fr.		2, 4, 8, 14
<i>Octospora leucoloma</i> (Hedw.: Fr.) Hedw.		2, 4, 8, 14

1 Abundante (más de 10 colectas)

2 Escaso (menos de 10 colectas)

3 Fimícola

4 Humícola

5 Lignícola

6 Terrícola

7 Micorrizico

■ Saprobionte

9 Parásito de plantas

10 Parásito de otros hongos

11 Parásito de insectos

12 Afinidad boreal

13 Afinidad tropical

14 Típico de bosque mesófilo

15 Amplia distribución

16 Afinidad austral

17 Especies boreales introducidas

" Nuevos registros para el  
bosque mesófilo de montaña

■ Nuevos registros para Veracruz

## HELOTIALES

<i>Chlorociboria aeruginascens</i> (Nyl.) Kanouse ex C.S.	2, 5, 8, 12
Ramamurthi, Korf & L. R. Batra	
<i>Dicephalospora rufocornea</i> (Berk. & Broome)	2, 5, 8, 14
Spooner	2, 5, 8, 12
<i>Helotium lobatum</i> Rich.	2, 5, 8, 13
<i>Lachnellula subtilissima</i> (Cooke) Dennis	2, 5, 8, 13
<i>Lachnum abnormis</i> (Mont.) Haines & Dumont	2, 5, 8, 13
<i>L. cyphelloides</i> (Pat.) Haines & Dumont	2, 5, 8, 13
<i>L. sclerotii</i> (A.L. Smith) Haines & Dumont	2, 5, 8, 13
<i>Pocillum cesatii</i> (Mont.) De Not.	2, 5, 8, 12

## BASIDIOMYCOTINA

## AURICULARIALES

<i>Auricularia cornea</i> (Ehenb.: Fr.) Ehrenb. ex. Endl.	1, 5, 8, 13
<i>A. delicata</i> (Fr.) Henn.	2, 5, 8, 13
<i>A. fuscisuccinea</i> (Mont.) Farl.	1, 5, 8, 13

## TREMELLALES

<i>Dacryopinax elegans</i> (Berk. & M.A. Curtis) G.W. Martin	1, 5, 8, 15
<i>D. spathularia</i> (Schwein.) G.W. Martin	1, 5, 8, 15
<i>Tremella fuciformis</i> Berk.	2, 5, 8, 15
<i>T. lutescens</i> Fr.: Fr.	2, 5, 8, 15

## APHYLLOPHORALES

## Thelephoraceae

<i>Cymatoderma caperatum</i> (Berk. & Mont.) Reid	2, 5, 8, 14
<i>Peniophora albobadia</i> (Schwein.: Fr.) Boid.	2, 5, 8, 14
<i>Stereum fasciatum</i> (Schwein.) Fr.	2, 5, 8, 15

## Hydnaceae

<i>Hydnum repandum</i> L.: Fr.	2, 7, 12
<i>Stecchericum seriatum</i> (Lloyd) Maas Geest.	2, 5, 8, 14

## Clavariaceae

<i>Clavicornia pyxidata</i> (Pers.: Fr.) Doty	2, 7, 14
<i>Clavulina amethystina</i> (Holmskj.: Fr.) Donk	2, 7, 14
<i>C. vermicularis</i> Sw.: Fr.	2, 7, 12
<i>Ramaria botrytis</i> (Pers.: Fr.) Ricken	2, 7, 12
<i>R. subbotrytis</i> (Coker) Corner	2, 7, 14

## Cantharellaceae

<i>Cantharellus cinnabarinus</i> (Schwein) Schwein.	2, 7, 12
<i>C. cibarius</i> (Fr.: Fr.) Fr.	2, 7, 12
<i>C. concinus</i> Berk.	2, 7, 14
<i>C. infundibuliformis</i> Fr.	2, 7, 14
<i>C. minor</i> Pk.	2, 7, 12
<i>C. tubaeformis</i> Fr.: Fr.	2, 7, 14
<i>Craterellus cornucopioides</i> var. <i>mediosporus</i> Corner	2, 7, 14
<i>Pseudocraterellus sinuosus</i> (Fr.) Corner ex Heinem.	2, 7, 14



**Polyporaceae**

	<i>Coltricia cinnamomea</i> (Jacq.) Murrill	1, 9, 12
	<i>C. perennis</i> (L.: Fr.) Gray	2, 9, 14
	<i>Coriolopsis polyzona</i> (Pers.) Ryvarden	2, 5, 8, 13
	<i>Cyclomyces tabacinus</i> (Mont.) Pat.	2, 5, 8, 13
"	<i>Datronia mollis</i> (Sommerf.: Fr.) Donk	2, 5, 8, 14
	<i>Earliella scabrosa</i> (Pers.) Gilb. & Ryvarden	2, 5, 8, 13
	<i>Echinochaete brachyporus</i> (Mont.) Ryvarden	2, 5, 8, 14
	<i>Fomitopsis cajanderi</i> (P. Karst.) Kotl. & Pouzar	2, 5, 8, 13
	<i>F. carnea</i> (Blume & Ness) Imazeki	2, 5, 8, 13
	<i>F. meliae</i> (Underw.) Gilbn.	2, 5, 8, 13
	<i>Ganoderma applanatum</i> (Pers.) Pat.	2, 5, 8, 14
	<i>G. curtisii</i> (Berk.) Murrill	2, 5, 8, 15
	<i>G. lucidum</i> (Leyss: Fr.) P. Karst.	2, 5, 8, 15
	<i>G. resinaceum</i> Boud.	2, 5, 8, 13
"	<i>Gloeophyllum sepiarium</i> (Fr.) P. Karst.	2, 5, 8, 12
	<i>G. striatum</i> (Swartz: Fr.) Murrill	1, 5, 8, 13
	<i>Hexagonia hirta</i> (Beauv.: Fr.) Fr.	2, 5, 8, 13
	<i>H. hydroides</i> (Fr.: Swartz) M. Fidalgo	2, 5, 8, 13
	<i>Hydnopolyporus fimbriatus</i> (Fr.) Reid	2, 9, 14
	<i>Laetiporus sulphureus</i> (Bull.: Fr.) Murrill	2, 5, 8, 15
	<i>Lenzites betulinus</i> (L.: Fr.) Fr.	2, 5, 8, 12
	<i>Nigroporus vinosus</i> (Berk.) Murrill	2, 5, 8, 14
■	<i>Oligoporus caesioides</i> (Schrab.: Fr.) Gilb. & Ryvarden	2, 5, 8, 13
	<i>Phellinus gilvus</i> (Schwein.: Fr.) Pat.	2, 5, 8, 12
	<i>Polyporus arcularius</i> Batsch: Fr.	1, 5, 8, 13
	<i>P. tricholoma</i> Mont.	1, 5, 8, 13
	<i>Pycnoporus sanguineus</i> (L.: Fr.) Murrill	2, 5, 8, 13
	<i>Rigidoporus ulmarius</i> (J. Sowerby: Fr.) Imazeki	1, 5, 8, 14
	<i>Trametes maxima</i> (Mont.) David & Rajchenb.	2, 5, 8, 13
	<i>T. versicolor</i> (L.: Fr.) Lloyd	1, 5, 8, 13
	<i>T. villosa</i> (Sw.: Fr.) Kreisel	1, 5, 8, 13
	<i>Trichaptum bififormis</i> (Fr.) Ryvarden	2, 5, 8, 12
	<i>Tyromyces galactinus</i> (Berk.) Lowe	2, 5, 8, 14

**AGARICALES****Hygrophoraceae**

	<i>Hygrocybe laeta</i> (Pers.: Fr.) P. Kumm.	2, 7, 14
	<i>Hygrocybe cantharellus</i> (Fr.) Murrill	2, 7, 12

**Tricholomataceae**

	<i>Armillaria mellea</i> (Vahl.: Fr.) P. Kumm.	2, 5, 9, 12
	<i>A. polymyces</i> (Pers.) Singer & Cléménçon	1, 5, 9, 14
	<i>A. tabescens</i> (Scop.: Fr.) Singer	1, 5, 9, 14
■	<i>Campanella merulina</i> (Pers.) Singer	2, 5, 8, 12
	<i>C. elongatispora</i> Singer	2, 5, 8, 14
	<i>Clitocybe gibba</i> (Pers.: Fr.) P. Kumm.	2, 7, 17
	<i>Collybia dryophila</i> (Bull.: Fr.) P. Kumm.	2, 7, 12
	<i>C. iocephala</i> (Berk. & Curtis) Singer	2, 7, 12
	<i>Dictyopanus pusillus</i> var. <i>rhpidium</i> (Berk.) Singer	2, 5, 8, 13

	<i>Hohenbuehelia petaloides</i> (Bull.: Fr.) Schulzer	2, 5, 8, 12
	<i>Laccaria amethystina</i> (Bolton.) Murrill	2, 7, 12
	<i>L. laccata</i> (Scop.: Fr.) Berk. & Broome	2, 7, 12
	<i>Lentinus boryanus</i> (Berk. & Mont.) Singer	2, 5, 8, 14
	<i>L. crinitus</i> (Linn: Fr.) Fr.	2, 5, 8, 13
	<i>L. levis</i> (Berk. & Curtis) Murrill	2, 5, 8, 14
	<i>Lepista nuda</i> (Bull.: Fr.) Cooke	2, 7, 12
	<i>Marasmius cohaerens</i> (Pers.: Fr.) Cooke & Bres.	2, 4, 8, 12
■	<i>Mycena chlorinosma</i> Singer	2, 4, 8, 12
	<i>M. pura</i> (Pers.: Fr.)	2, 4, 8, 12
	<i>Neolentinus lepideus</i> (Fr.: Fr.) Redhead & Ginns	2, 5, 8, 17
	<i>Oudemansiella canarii</i> (Jungh.) Höhn.	1, 5, 8, 13
	<i>O. radicata</i> (Rehl.: Fr.) Singer	2, 4, 8, 13
	<i>Pleurotus djamor</i> (Rumph.: Fr.) Boedijn var. <i>djamor</i>	1, 5, 8, 13
	<i>P. djamor</i> var. <i>roseus</i> Corner	2, 5, 8, 13
	<i>P. smithii</i> Guzmán	2, 5, 9, 16
	<i>Schizophyllum commune</i> Fr.: Fr.	1, 5, 8, 13
	<i>S. fasciatum</i> Pat.	2, 5, 8, 13
	<i>Tricholoma flavovirens</i> (Pers.: Fr.) S. Lundell	2, 5, 8, 12
	<i>Tricholomopsis platyphylla</i> (Pers.: Fr.) Singer	2, 5, 8, 12
	<i>Xeromphalina tenuipes</i> (Schwein.) A. H. Sm.	2, 5, 8, 15
<b>Amanitaceae</b>		
"	<i>Amanita annulatovaginata</i> Beeli	2, 7, 13
	<i>A. flavoconia</i> G.F. Atk.	2, 7, 12
	<i>A. fulva</i> (Schaeff.: Fr.) Fr.	2, 7, 12
	<i>A. gemmata</i> (Fr.) Bertillon var. <i>gemmata</i>	1, 7, 14
	<i>A. hemibapha</i> (Berk. & Broome) Sacc.	1, 7, 14
	<i>A. rubescens</i> (Pers.: Fr.) Gray	2, 7, 12
	<i>A. vaginata</i> (Bull.: Fr.) Vittad.	2, 7, 12
	<i>A. virosa</i> (Lam.) Bertillon	1, 7, 14
<b>Agaricaceae</b>		
"	<i>Agaricus placomyces</i> Peck	2, 4, 8, 12
	<i>A. volvatulus</i> R. Heim & Goss. Font.	2, 4, 8, 14
■	<i>Lepiota atrodisca</i> Zeller	2, 4, 8, 13
	<i>L. cristata</i> (Bolt.: Fr.) P. Kumm.	2, 4, 8, 13
■	<i>Leucoagaricus meleagris</i> (J. Sowerby) Singer	2, 4, 8, 13
	<i>L. rubrotincta</i> (Peck) Singer	2, 4, 8, 13
	<i>Leucocoprinus flos-sulfuris</i> (Schniz.) Cejp	2, 4, 8, 15
<b>Coprinaceae</b>		
	<i>Coprinus atramentarius</i> (Bull.: Fr.) Fr.	2, 4, 6, 8, 12
	<i>C. disseminatus</i> (Pers.: Fr.) Gray	1, 4, 5, 8, 12
	<i>Panaeolus subbalteatus</i> (Berk. & Broome) Sacc.	2, 6, 8, 12
<b>Bolbitiaceae</b>		
	<i>Conocybe lactea</i> (Lange) Métrod	1, 6, 8, 14
<b>Strophariaceae</b>		
	<i>Hypholoma aurantiacum</i> (Cooke) Faus ex Krieglsteiner	2, 4, 6, 8, 14
	<i>H. fasciculare</i> (Huds.: Fr.) P. Kumm.	2, 5, 8, 12

<i>H. subviride</i> (Berk. & M.A. Curtis) Dennis	1, 5, 6, 8, 14
<i>Psilocybe coprophila</i> (Bull.: Fr.) P. Kumm.	2, 3, 8, 15
<i>P. cubensis</i> (Earle) Singer	2, 3, 8, 13
<i>P. zapotecorum</i> R. Heim emend. Guzmán	2, 6, 8, 14
<i>Stropharia coronilla</i> (Bull.: Fr.) Quél.	2, 6, 8, 12

**Cortinariaceae**

■ <i>Cortinarius caerulescens</i> (Schaeff.) Fr.	2, 7, 14
<i>Crepidotus mollis</i> (Schaeff.: Fr.) Staude	2, 5, 8, 12
<i>C. uber</i> (Berk. & M.A. Curtis) Sacc.	2, 5, 8, 14
■ <i>Inocybe hystrix</i> (Fr.) P. Karst.	2, 7, 14
<i>I. jalapensis</i> (Murrill) Singer	2, 7, 14

**Entolomataceae**

<i>Entoloma murraili</i> (Berk. & M.A. Curtis) Sacc.	2, 7, 14
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**Boletaceae**

<i>Austroboletus subflavidus</i> (Murrill) Wolfe	2, 7, 14
<i>Boletellus ananas</i> (M.A. Curtis) Murrill	2, 7, 14
" <i>Boletus erythropus</i> Pers.	2, 7, 12
<i>Gyroporus castaneus</i> (Bull.: Fr.) Quél.	2, 7, 12
<i>Porphyrellus</i> cf. <i>porphyrosporus</i> (Fr. in Hök) J.E. Gilbert	2, 7, 12
<i>Pulveroboletus auriporus</i> (Peck) Singer	2, 7, 14
<i>P. caespitosus</i> (Peck) Singer	2, 7, 14
<i>Strobilomyces floccopus</i> (Vahl: Fr.) P. Karst.	2, 7, 12
<i>Suillus americanus</i> (Peck) Snell	2, 7, 17
<i>S. brevipes</i> (Peck) Kuntze	2, 7, 17
<i>S. truncatus</i> Singer, Snell & Dick	2, 7, 17
<i>Tylopilus balloui</i> (Peck) Singer	1, 7, 12
■ <i>T. subcellulosus</i> Singer, García & Gómez	1, 7, 14
■ <i>T. tabacinus</i> (Peck) Singer	2, 7, 14
" <i>Xerocomus chrysenteron</i> (Bull.) Quél.	2, 7, 17
<i>X. illudens</i> (Peck) Singer	2, 7, 14
<i>X. truncatus</i> Singer, Snell & Dick	2, 7, 12

**Russulaceae**

<i>Lactarius chrysorheus</i> Fr.	2, 7, 12
<i>L. deliciosus</i> (L.: Fr.) Gray	2, 7, 17
<i>L. indigo</i> (Schwein.) Fr.	1, 7, 14
■ <i>L. volemus</i> (Fr.: Fr.) Fr.	2, 7, 12
■ <i>L. vellereus</i> (Fr.) Fr.	2, 7, 12
<i>Russula brevipes</i> Peck	2, 7, 12
■ <i>R. lepida</i> (Fr.: Fr.) Fr.	2, 7, 12
■ <i>R. lutea</i> Huds. ex Gray	2, 7, 12
<i>R. foetens</i> Pers.: Fr.	1, 7, 12
<i>R. mephritica</i> Pegler	2, 7, 14
<i>R. nigricans</i> Bull.: Fr.	2, 7, 17
■ <i>R. virescens</i> (Schaeff.) Fr.	1, 7, 12

**GASTEROMYCETES****Clathraceae**

<i>Aseroe rubra</i> Labill.	2, 4, 8, 14
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<i>Blumenavia rhacodes</i> A. Möller	2, 4, 8, 14
<i>Clathrus columnatus</i> Bosc	2, 4, 8, 14

**Calostomataceae**

<i>Calostoma cinnabarina</i> Desv.	2, 4, 8, 14
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**Lycoperdaceae**

■ <i>Bovista fusca</i> Lév.	2, 7, 12
<i>Calvatia cyathiformis</i> (Bosc) Morgan	2, 7, 12
<i>Lycoperdon perlatum</i> Pers.: Pers.	2, 7, 17
<i>L. umbrinum</i> Pers.: Pers.	2, 7, 12
<i>Vascellum intermedium</i> A.H. Sm.	2, 6, 8, 14
<i>V. pratense</i> (Pers.: Pers.) Kreisel	2, 6, 8, 14

**Geastraceae**

<i>Geastrum saccatum</i> (Fr.) E. Fisch.	2, 4, 8, 12
<i>G. triplex</i> Jungh.	2, 4, 8, 15

**SCLERODERMATALES****Sclerodermataceae**

<i>Pisolithus arhizus</i> (Pers.) Rauschert.	2, 7, 17
<i>Scleroderma areolatum</i> Ehrenb.	2, 7, 17
<i>S. cepa</i> Pers.: Pers.	2, 7, 12
<i>S. citrinum</i> Pers.: Pers.	2, 7, 12
<i>S. verrucosum</i> (Bull.: Pers.) Pers.	2, 7, 12
<i>Veligaster nitidum</i> (Berk.) Guzmán & Tapia	1, 7, 14

**Nidulariaceae**

<i>Cyathus olla</i> (Batsch: Pers.) Pers.	2, 5, 8, 15
<i>C. stercoreus</i> (Schwein.) De Toni	2, 3, 8, 15
<i>C. striatus</i> (Huds.: Pers.) Willd.	2, 5, 8, 12

## STUDI SULLE *BOLBITIACEAE* DELLA SARDEGNA 1 — TRE NUOVE SPECIE NEI GENERI *AGROCYBE* E *PHOLIOTINA*

Marco CONTU

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**ABSTRACT** — Three new species in family *Bolbitiaceae* are described from Sardinia: *Agrocybe cyanescens*, spec. nov., close to *A. pusiola*, *Phliotina galerinoides*, spec. nov., belonging with the section *Piliferae* is closed to *P. aberrans* and *P. veregregia* spec. nov. is close to *P. coprophila*.

**KEY WORDS** — Basidiomycotina; Agaromycetidae; *Bolbitiaceae*; *Agrocybe*; *Phliotina*; Sardinia

**RÉSUMÉ** - Trois nouvelles espèces de la Sardaigne sont décrites dans les *Bolbitiaceae* : *Agrocybe cyanescens*, proche de *A. pusiola*, *Phliotina galerinoides*, de la section *Piliferae*, proche de *P. aberrans* et *P. veregregia*, voisine de *P. coprophila*.

**MOTS CLÉS** — Basidiomycotina; Agaricomycetidae; *Bolbitiaceae*; *Agrocybe*; *Phliotina*; Sardaigne.

### INTRODUZIONE

Nel corso di ricerche, intraprese ormai da tempo, sulla flora micologica della Sardegna, ho avuto occasione di studiare tre nuove specie di *Bolbitiaceae* la cui descrizione costituisce l'oggetto della presente comunicazione.

Il materiale d'erbario di tutte le entità si trova attualmente depositato nell'Erbario dell'Istituto ed Orto Botanico dell'Università di Cagliari (CAG).

La descrizione adottata è quella di M. Bon (1992) e Singer (1986).

#### 1 — *Agrocybe* Fayod

Dopo la pubblicazione dello studio di Ballero & Contu (1990) sull'ecologia e la diffusione del genere nell'isola lo stato delle conoscenze sullo stesso può ritenersi soddisfacente, tenuto anche conto che alle 15 specie ivi citate vanno aggiunte la nuova *A. metuloidaephora*, da ascrivere (forse provvisoriamente!) alla sect. *Microspora* Sing. (Ballero & Contu, 1991: 151-153) ed altre specie, fra le quali diverse di origine americana.

Le ricerche condotte in vista di uno studio floristico-tassonomico (di imminente completamento e pubblicazione) hanno portato all'individuazione della seguente nuova entità, appartenente al complesso facente capo ad *A. pusiola* (Fr.) Heim (= *pusilla*).

***Agrocybe cyanescens* Contu spec. nov.**

*Pileus* 0.5-1.5 cm *latus*, *semiglobosus*, *siccus*, *haud hygrophanus*, *extriatus*, *flavo-citrinusi*. *Lamellae subconfertae, adnatae, brunneo-tabacinae, acies albida*. *Stipes* 1.8-3.6 × 0.05-0.1 cm, *cylindraceus, fibrilloso-striolatus, evelatus*. *Caro parce conspicua, pallida, typice tactu intus extusque cyanescens; odor saporque debiles, raphanacei*.

*Sporarum pulvis brunneo-tabacina*.

*Sporae* 7-9 × 4.5-6 µm, *haud obscurae, ellipsoideae vel obovatae, crassotunicatae, haud poratae*. *Basidia* 15-22 × 6-7 µm, *tetraspora*. *Pleurocystidia* 45-75 × 10-15 × 4.5-6.7 µm, *numerosa, lageniformia vel fusiformia, tenuitunicata, haud incrustata*. *Cheilocystidia* *phurocystidia simillima; paracystidia frequentia, clavata, 9-19 µm lata, tenuitunicata, haud incrustata*. *Pilei cutis hymeniformis, ex cellulis clavatis 9-15 µm latis constituta, pigmento intracellularis, in subcute intraparietalis*. *Dermatocystidia atque caulocystia nulla vel rariora*. *Fibulae numerosae*.

*Hab.* — *solitaria in herbidis locis vel in fruticibus dunensis. Autumno. Rara. Typus: Italia, Sardinia, prov. Cagliari, Serramanna, 13.XI.1993, leg. P. Dessì, M. Contu C50 (CAG!).*

Cappello 0.5-1.5 cm, poco carnoso, convesso-emisferico, raramente con margine revoluto, non umbonato, secco, non striato, giallo-ocra pallido, citrino o francamente giallo-tuorlo, margine senza resti di velo. Lamelle sottili e relativamente strette, mediamente fitte, adnato-annesse, bruno-tabacco chiare, taglio bianco. Gambo 1.8-3.6 × 0.05-0.1 cm, cilindrico a base un poco ingrossata, non bulboso, senza sclerozio basale, longitudinalmente fibrilloso-striolato, concolore al cappello, senza resti di velo; micelio bianco. Carne poco consistente, fragile, pallidamente giallastra, tipicamente virante al blu-verde al tocco nelle superfici esterne ed interne (talvolta tale viraggio è visibile solo nella metà inferiore del gambo 1); odore e sapore leggeri, lievemente rafanoidi o di patata. Probabilmente non commestibile.

Sporata bruno-tabacco.

Spore 7-9 × 4.5-6 µm, non scure, ellissoidi o ellisso-ovoidi, a parete mediamente spessa, senza poro apicale. Basidi 15-22 × 6-7 µm, tetrasporici, clavati; subimenio cellulare-polygonale. Trama dell'imenoforo parallela. Pleurocistidi 45-75 × 10-15 µm, frequenti, lageniformi o subfusiformi, a parete sottile o solo leggermente spessa, non incrostati, collo largo 4.5-6.7 µm, sovente substrangolato e capitulato. Cellule marginali: a) cheilocistidi simili ai pleurocistidi in forma e dimensioni, frequenti, b) paracistidi clavati, sferopedunculati e con tutte le forme di transizione verso i cheilocistidi, larghi 9-15 (19) µm. Rivestimento pileico formato da un imeniderma non gelatinoso di ife clavate, larghe 9-15 µm, con pigmento intracellulare; ife della subcutis cilindriche ed intrecciate, con pigmento intraparietale. Giunti a fibbia frequenti ovunque.

*Hab.* — *solitaria in località erbose, sovente in terreni sabbiosi e/o a forte influenza antropica. Autunno. Rara.*

Materiale esaminato: — Italia, Sardegna, prov. Cagliari, Serramanna, 13.11.1993, leg. P. Dessì, M. Contu C50 (typus, CAG!); — ditto, prov. Cagliari, Villasi-mius, 26.11.1991, leg. M. Contu; — ditt, prov. Cagliari, Chia, 24.10.1993, leg. M. Contu, M. Contu 92/81,

Osservazioni — A causa delle spore prive di poro germinativo questa entità appartiene al subgen. *Aporus* Sing. e, per l'imenio pleurocistidiato e l'assenza di velo trova posto nella sezione *Evelatae* Sing. Essa somiglia soprattutto all'europea *A. pusilla* (Fr.) Heim (= *pusilla*), molto comune in Sardegna, dalla quale differisce non solo per il viraggio al blu-verde delle superfici esterne ed interne del carpoforo ma anche per il fatto di presentare, nel taglio lamellare, accanto ai cheilocistidi pleurocistidioidi lageno-fusiformi, anche numerosi paracistidi clavati o sferopedunculati, con tutte le forme di transizione fra l'un elemento e l'altro, un carattere che ricorda certe specie di *Psathyrella* e *Inocybe*.

Il viraggio al blu-verde della carne del carpoforo fresco è circostanza che induce a ritenere presumibile che, similmente ad altre *Bolbitiaceae* come *Pholiotina cyanopus* (Atk.) Sing., *A. cyanescens* sia una specie psicotropa.

## II - *Pholiotina* Fayod

Le notizie sulla diffusione del genere in Sardegna sono praticamente nulle, se si eccettuano alcune brevi segnalazioni del presente autore (Contu, 1993: 59) concernenti *P. brunnea* e *P. striipes*. Risultano, tuttavia, nell'Erbario CAG diverse collezioni relative ad entità ascrivibili a *Pholiotina* la cui identità permane, allo stato, da confermare. Le due specie descritte di seguito sono state osservate in diverse occasioni in località della Gallura, nella Sardegna settentrionale: esse possiedono combinazioni di caratteri affatto originali e vanno, pertanto, considerate nuove per la scienza.

### *Pholiotina galerinoides* Contu spec. nov.

*Pileus* 0.2-0.6 cm latus, parvissime carnosus, campanulato-mycenoideus, exumbonatus, levis, hygrophanus, pallide ochro-alutaceus, ad medium saepe obscurior, iove pluvio omnino striatus, margine sine veli vestigia. Lamellae tenues, strictae, confertae, subliberae, ochraceae dein pallide subrubiginosae. Stipes 3-4.5 × 0.05-0.1 cm, cylindraceus, levis, sericeus, pileo concolor vel leviter pallidior, mycelio albo. Caro inconspicua, fragillima, pallide ochraceo-sericea; odor saporque nulli. Sporarum pulvis ochracea. Sporae 5.2-7.5 × 3.7-4.5 µm, pallide rubiginosae, ellipso-ovoideae, poro apicali parvo praeditae, leves, parietibus incrassatis. Basidia 13.5-18 × 6-9 µm, tetraspora, clavata. Pleurocystidia nulla. Cheilocystidia 22.5-67.5 × 6-12 µm, cervix 3-5.2 µm lat., fusiformia vel lageniformia, tenuitunicata, haud incrassata. Pilei cutis ex cellulis clavatis 13-20 µm lat. dermatocystidiisque lageniformibus vel fusiformibus 46.5-115.5 × 8.2-12 × 3 — 5 µm lat. constituta; pigmento intracellularis. Caulocystidia frequentia, fusiformia, usque ad 60 × 12 × 5 µm lat. Fibulae numerosae.

*Hab.* — inter muscos, in locis montanis, hygrophila. Autumno. Rara. Typus: Italia, Sardinia, prov. Sassari, Monte Limbara, loc. Vallicciola, 16.9.1995, leg. M. Contu (CAG!).

Cappello 0.2-0.6 cm, pochisimo carnoso, convesso-micenoide, simile a molte *Galerina*, non umbonato, liscio, glabro, igrofano, ocreo-alutaceo pallido, più scuro verso il centro, a tempo umido interamente striato per trasparenza, margine senza resti di velo. Lamelle sottili, strette, fitte, sublibere, ocracee poi pallidamente rugginose, taglio subconcolore. Gambo 3-4.5 × 0.05-0.1 cm, cilindrico, liscio, sericeo, concolore al cappello o leggermente più pallido, micelio bianco. Carne esigua, inconspicua, fragilissima, pallidamente ocreo-sericea; odore e sapore nulli.

Sporata fulvo-ruggine pallida.

Spore  $5.2-7.5 \times 3.7-4.5 \mu\text{m}$ , rugginose, ellisso-ovoidi, con poro apicale ridotto ma evidente, a parete spessa, lisce. Basidi  $13.5-18 \times 6-9 \mu\text{m}$ , tetrasporici, clavati; subimenio confuso, filamentoso. Trama dell'imenoforo parallela. Pleurocistidi assenti. Cheilocistidi  $22.5-67.5 \times 6-12 \mu\text{m}$ , abbondanti, fusiformi o lageniformi, a collo non strangolato e non capitulato, largo  $3-5.2 \mu\text{m}$ . Rivestimento pileico formato da un imeniderma di cellule clavate larghe  $13-20 \mu\text{m}$ , con pigmento intracellulare; dermatocistidi numerosi, fusiformi,  $46.5-111.5 \times 8.2-12 \times 3-5 \mu\text{m}$ , simili ai cheilocistidi. Caulocistidi frequenti lunghi fino a  $60 \mu\text{m}$  e larghi fino a  $12 \mu\text{m}$ , con collo spesso fino a  $5 \mu\text{m}$ , simili ai cheilocistidi. Giunti a fibbia numerosi.

Hab. — a piccoli gruppi, fra muschi, in località di alta montagna, tipicamente igrofila. Autunno. Rara.

Materiale studiato: — Italia, Sardegna, prov. Sassari, Monte Limbara, 100 m s.l.m., 16.9.1995, leg. M. Contu (typus, CAG!). Diverse altre raccolte, nel 1995 e nel 1996, sempre nella stessa località.

Osservazioni — Questa nuova specie deve essere inserita nella sezione *Piliferae* (Kuhn.) Sing. in vicinanza di *P. aberrans* (Kuhn.) Sing. dalla quale si distingue nettamente per le spore decisamente più piccole e l'habitat muscicolo-igrofilo. Fra le rimanenti entità della sezione una confusione potrebbe essere astrattamente possibile anche con *P. parvula* (Dossing & Watl.) M. Bon la quale, tuttavia, differisce per la diversa forma dei cistidi (subcilindrici), le ife prive di giunti a fibbia e l'habitat boschivo.

L'aspetto peculiare potrebbe agevolare confusioni con qualche *Galerina* della sezione *Mycenoides* (inde nomen!) ma queste specie possiedono, fra l'altro, un rivestimento pileico a struttura filamentosa.

### *Pholiotina veregregia* Contu spec. nov.

*Pileus 0.8-2 cm latus, parce carnosus, semiglobosus, exumbonatus, viscidulus, hygrophanus, lavo-brunneus dein alutaceus, iove pluvio omnino striatus, typice semper pruina alba oblecto. Lamellae modice confertae, tenues, adnexae, flavo-ochraceae deinde obscuriores, acies concoloratae. Stipes 1.3-3.6 × 0.1-0.2 cm, brevis, fragilis, cylindraceus, ad basim leviter inflatus, siccus, albidus, omnino albo-pruinosis; mycelio basali albo. Caro fragilis, pallide brunneo-acquosa; odor saporque debiles.*

*Sporarum pulvis ochro-tabacina.*

*Sporae 9-12 × 6-8.2 μm, ochraceae, ellipsoideae vel obovatae, poro apicali centralis, conspicuo, instructae, crassotunicatae, leves. Basidia 18-30 × 10.5-13.5 μm, tetraspora, clavata. Pleurocystidia nulla. Cheilocystidia 18-45.7 × 7-12 μm, cervix 3-7.5 μm lat., lageniformia, cervix strangulatus, saepe capitulatus, tenuitunicata, haud incrustata. Pilei cutis ex hyphis clavatis, 9-21 μm lat., constituta, pigmento intraparietalis, dermatocystidia nulla vel rariora. Caulocystidia cheilocystidia simillima sed majora. Fibulae numerosae.*

Hab. — in fimo bovino, parce graegaria. Autunno. Rara. Typus: Italia, Sardinia, prov. Sassari, Tempio P. — Oschiri, loc. Balascia, 31.12.1994, leg. M. Contu (CAG!).

Cappello 0.8-2 cm, poco carnoso, emisferico, non umbonato, a tempo umido interamente striato per trasparenza e notevolmente viscoso, tipicamente coperto da una pruina glassosa bianca, igrofano, da giallo-bruno ad alutaceo pallido, senza sfumature rossastre, margine senza resti di velo. Lamelle sottili, strette, poco fitte, annesse, giallo-ocracee poi brunastro-rugginose, taglio concolore. Gambo  $1.3-3.6 \times 0.1-0.2 \text{ cm}$ , corto



rispetto al diametro del cappello, cilindrico, sovente allargato verso la base, bianco, interamente fioccoso-pruinoso; micelio bianco. Carne fragile, brunastro-acquosa; odore e sapore deboli.

Sporata brunastro-ocracea.

Spore  $9-12 \times 6-8.2 \mu\text{m}$ , ocracee relativamente pallide, ellissoidi o ellisso-ovoidi, poro apicale netto e centrale, a parete spessa, lisce. Basidi  $18-30 \times 10.5-13.5 \mu\text{m}$ , tetrasporici, clavati. Subimenio e trama dell'imenoforo banali, senza peculiarità. Pleurocistidi assenti. Cheilocistidi  $18-45.7 \times 7-12 \mu\text{m}$ , lageniformi a collo spesso  $3-7.5 \mu\text{m}$  e strangolato, sovente capitulato, a parete sottile, non incrostati. Rivestimento pileico composto da un imeniderma di cellule clavate larghe  $9-21 \mu\text{m}$ ; pigmento intraparietale; dermatocistidi assenti o molto rari. Caulocistidi frequenti, simili ai cheilocistidi ma più grandi. Giunti a fibbia abbondanti.

Hab. — su sterco bovino, gregario, specialmente dopo forti piogge. Autunno.

Rara.

Materiale esaminato: — Italia, Sardegna, prov. Sassari, strada Tempio P.-Oschiri, loc. Balascia, 31.12.1994, leg. M. Contu (typus, CAG!); — ditto, 16.1.1995, leg. M. Contu.

Osservazioni. — Questa specie è incontestabilmente molto simile a *P. coprophila* (Kuhn.) Sing., crescente in habitat simile, ma si differenzia chiaramente per il cappello nettamente striato, tipicamente coperto da un'abbondante pruina glassosa bianca e, micromorfologicamente, per le ife munite di giunti a fibbia. Le rimanenti entità del genere risultano anche più differenti sia per l'ecologia non fimicola, sia per la presenza di velo, sia per la micromorfologia (forma e dimensioni delle spore e dei cistidi, etc.).

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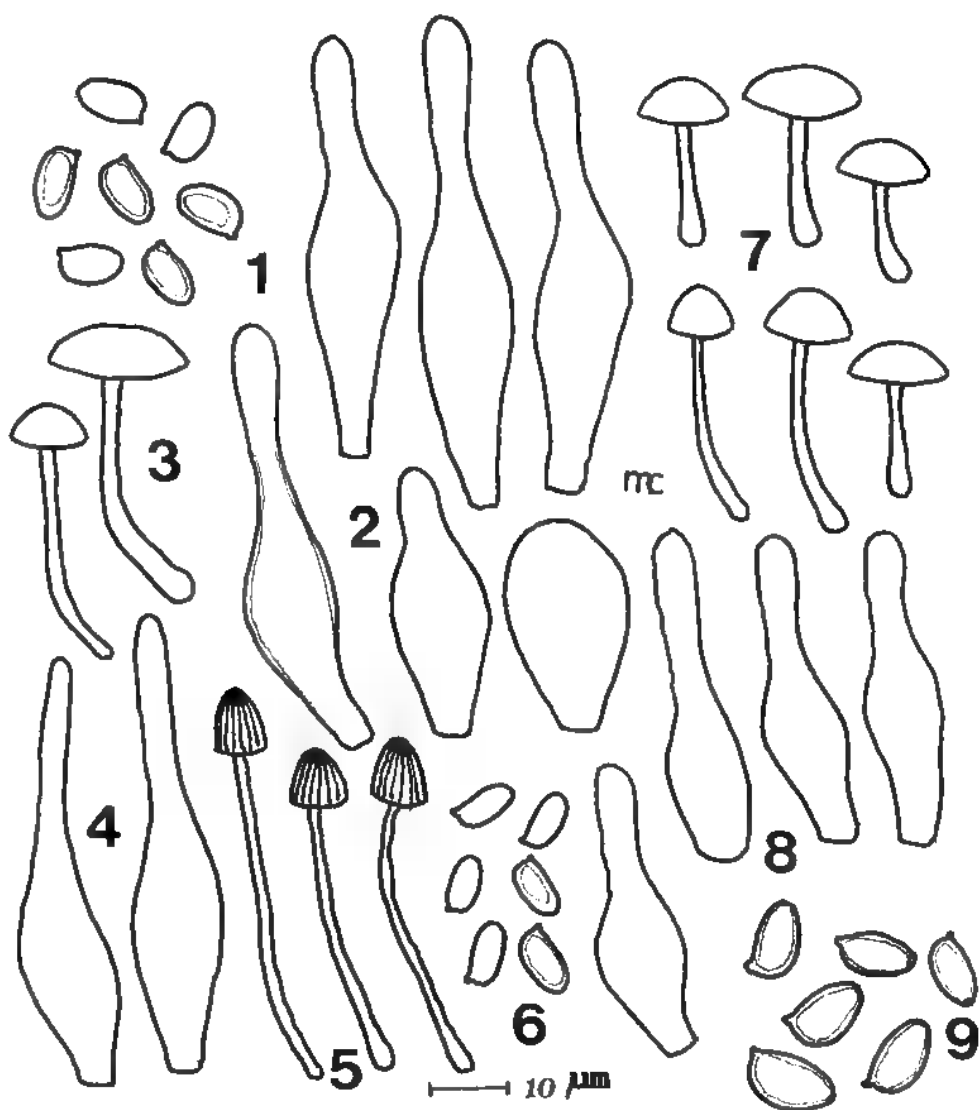


Fig. 1-3. — *Agrocybe cyanescens*; 1: spore, 2: pleurocystidi, 3: carpofori.

Fig. 4-6. — *Pholiotina galerinoides*; 4: cistidi, 5: carpofori, 6: spore.

Fig. 7-9. — *Pholiotina veregregia*; 7: carpofori, 8: cheilocystidi, 9: spore.

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Commission paritaire 16-4-1986 - N° 58611 - Dépôt légal 4<sup>e</sup> trimestre 1997 - Imprimerie F. Paillart  
Sortie des presses le 31 décembre 1997 - Imprimé en France  
Éditeur : A.D.A.C. (Association des Amis des Cryptogames)  
Président : D. Lamy ; Secrétaire : B. Dennetière  
Trésorier : M<sup>me</sup> E. Bury ; Directeur de la publication : H. Causse



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